INSTRUCTION MANUAL

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EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation Division
Los Angeles, California 90066

OPERATION & SERVICE MANUAL

FOR

NOISE-GAIN ANALYZER

MODEL 2075

Manual No. 1-500783-375

004

Eaton Corporation
Electronic Instrumentation Division
Los Angeles Plant
5340 Alla Road
Los Angeles, California 90066

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1. Model or Type
2. Serial Number
3. Description of trouble(1)
4. Approximate date instrument was placed in operation.
5. Approximate number of hours in use.
6. Maintenance action previously requested or performed.
7. Other comments.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

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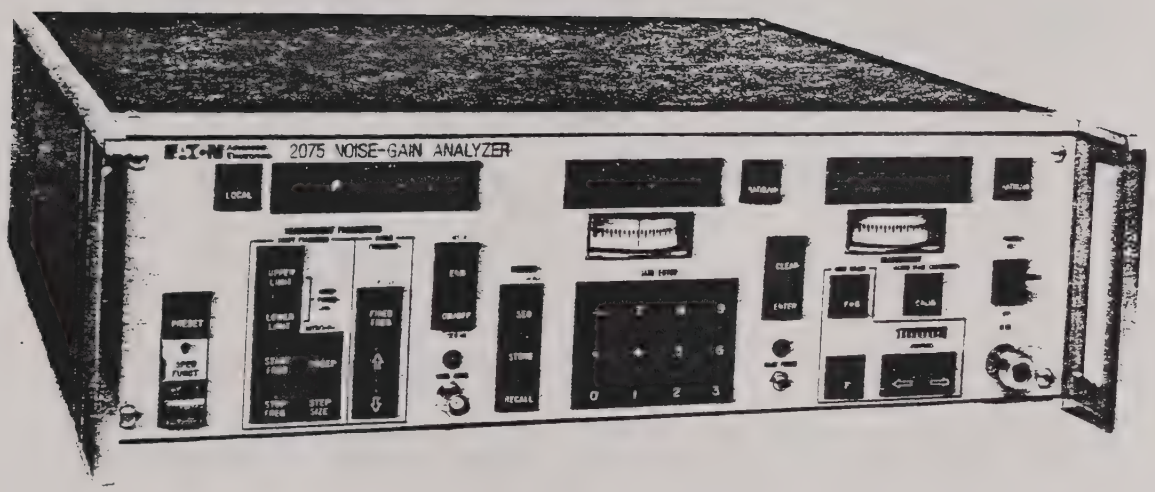


Figure 1-1. Noise-Gain Analyzer, Model 2075

Section I

INTRODUCTION

1.1 SCOPE OF MANUAL

This manual contains operating and maintenance information for the Model 2075 Noise-Gain Analyzer (Figure 1-1). The manual is divided into seven sections:

1) Introduction to the Manual
2) Specifications
3) Controls, Switches, Indicators, and Receptacles
4) Installation Instructions
5) Operation
6) GPIB Operation
7) Schematics

1.2 PURPOSE AND USE OF EQUIPMENT

This Manual is designed to provide the technical information required to install, operate, and test the 2075 Noise-Gain Analyzer.

1.3 APPROACH TO MAINTENANCE

To assure accuracy, periodically check the performance of the 2075 and perform the suggested calibration procedures at the specified intervals. See Section 5.6, "Calibration, IF Attenuators", and "Service Aid, Detector Voltages And Attenuator Settings."

1.4 SUPPLIED ACCESSORIES

The items listed in Table 1-1 are furnished with the Model 2075.

TABLE 1-1. Supplied Accessories

QUANTITY	DESCRIPTION	PART NUMBER
1	AC Power Cord, 7.5 feet	1-910166-001
1	Mini Phone Plug	1-910417-101
1	Operation and Service Manual	1-500783-375
1	Fuse 1.0 Amp	1-924000-019

1.5 OPTIONAL ACCESSORIES

Accessories available for use with the Model 2075 are listed in Table 1-2.

TABLE 1-2. Optional Accessories

ITEM NO.	DESCRIPTION	PART NUMBER
1	GPIB (IEEE-488) Cable - 1 meter	1-998094-001
2	GPIB (IEEE-488) Cable - 2 meter	1-998094-002
3	GPIB (IEEE-488) Cable - 4 meter	1-998094-003
4	Noise Source, 10 Mhz to 1500 Mhz.	Model 7615
5	Noise Source, 1 GHz to 12.4 GHz	Model 7616
6	Noise Source, 12.4 GHz to 18 GHz	Model 7617
7	Noise Source, 1 GHz to 18 GHz	Model 7618
8	Noise Source, 10 MHz to 18 GHz	Model 7618E
9	Noise Source, 10 MHz to 26.5 GHz	Model 7626
10	Gas Discharge NS Power Supply	Model 7175
11	8.2 to 40 GHz waveguide gas-discharge NS.	70 Series

1.6 MAINTENANCE KITS

An optional service kit (extender cards and cables) and anti-static kit are also available as follows:

Maintenance Kit	1-006586-001
Anti-Static Workstation	1-998484-001

Section II

SPECIFICATIONS

2.1 INTRODUCTION

This section contains two tables which cover specification information for the Model 2075. Table 2-1 gives the basic specifications and has three columns. Column one is a list of the instrument's various characteristics and column two gives the related specifications and ranges. The third column supplies additional information such as definitions of the specifications.

Table 2-2 contains supplemental specifications.

2.2 SPECIFICATIONS

Tables 2-1 through 2-2 contain specification data for the Model 2075.

Table 2-1. Eaton 2075 Specifications

CHARACTERISTIC	SPECIFICATION	INFORMATION
NOISE FIGURE MEASUREMENT		
Range :	0 to 30 dB	
Resolution :	0.01 dB	
Instrumentation : Uncertainty	± 0.05 dB	± 0.05 dB (a) 0 to 12 dB noise figure (b) +10 to +40°C (c) ENR 5 to 18 dB
		± 0.1 dB (a) F > 12 dB (b) T < 10°C, > 40°C

Table 2-1. Eaton 2075 Specifications (Cont.)

CHARACTERISTIC	SPECIFICATION	INFORMATION
GAIN MEASUREMENT		
Range :	-20 to >+50 dB	
Resolution :	0.01 dB	
Instrumentation :		
Uncertainty	± 0.2 dB	
INPUT		
Frequency Range :	Tunable from 10 to 1800 MHz	
Frequency Resolution :	0.1 MHz	
Tuning Accuracy :	± (0.5 MHz + 0.005 f) ± 3 MHz maximum	
Second Stage : Noise Figure :	< 7 dB +.001 dB/MHz	For input power levels below -40 dBm.
Input SWR : (Reflection Coefficient) :	<1.5:1 0.2	
Maximum Net External Gain :	> 75 dB	
ELECTROMAGNETIC COMPATIBILITY EMI		
	MIL STD 461A, CISPR publication 11, and Messempfaenger-Postverfuegung 526/527/79	Conducted and radiated interference is in compliance with MIL STD 461A Methods CE03 and RE02, CISPR publication 11 (1975), and Messempfaenger-Postverfuegung 526/527/79 (Kennzeichnung Mit F-Nummer/ Funkschutzzeichen)
Conducted and Radiated Susceptibility :	MIL STD 461A-1968	Conducted and radiated susceptibility meets the requirement of methods CS01, CS02, CS06, and RS03 (1 Volt/meter of MIL STD 461A dated 1968

Table 2-1. Eaton 2075 Specifications (Cont.)

CHARACTERISTIC	SPECIFICATION	INFORMATION
GENERAL		
Noise Source Drive :	28.0 ± 0.05 V	Noise source ON at up to 100 mA peak
	< 1.0 V	Noise source OFF
Power Requirements Line Voltage :		
100, 120, 220 or 240 V	± 10%	48 to 66 Hz
Power Dissipation :	200 V A maximum	
Temperature :		
Operating	0 to 55 °C	
Storage	-55 to 75 °C	
Remote Operation (HP-IB) :	IEEE STD 488-1978 Compatibility Code: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C1, C3, C28, E1	IEEE STD 488-1978, "Digital Interface for Programmable Instruction". Most functions are remotely programmable
Dimensions :		
Height	146 mm (5.75 in)	5-1/4" rack level space
Width	425 mm (16.8 in)	
Depth	354 mm (14.0 in)	
Net Weight :	15.5 kg (34 lbs)	

Table 2-2. Supplemental Specifications

SUPPLEMENTAL	
Bandwidth :	4.2 MHz Noise Bandwidth (nominal)
Maximum Safe Input Level :	± 20 Vdc; +20 dBm RF

Table 2.2. Supplemental Specifications (Cont.)

FEATURES	FUNCTION	
Noise Figure Display	F dB	Noise figure in dB
	F	Nose figure in ratio
	Y dB	Y-Factor in dB
	Y	Y-Factor in ratio
	M dB	Noise measure in dB
	M	Noise measure in ratio
	Te (K)	Effective noise temp (K)
	T op(K)	Operating noise temp (K)
Display Control	Default display is FdB	
Controller Functions :	HP8672A, HP8350A, Wiltron 6600 Series Sweep Generators, GIGA Sweeper, General Format	
ENR Storage Capacity :	3 sets at 31 freqs, 1 optional ROM input (4 total)	
Analog Display Setup :	F & G minimum to maximum, front panel.	
External Relay Drive :	+5, +15, or +30 V operation selected by internal jumper. Available current: +5V up to 5 VA max. +15V up to 4.5 VA max +30V up to 15 VA max.	

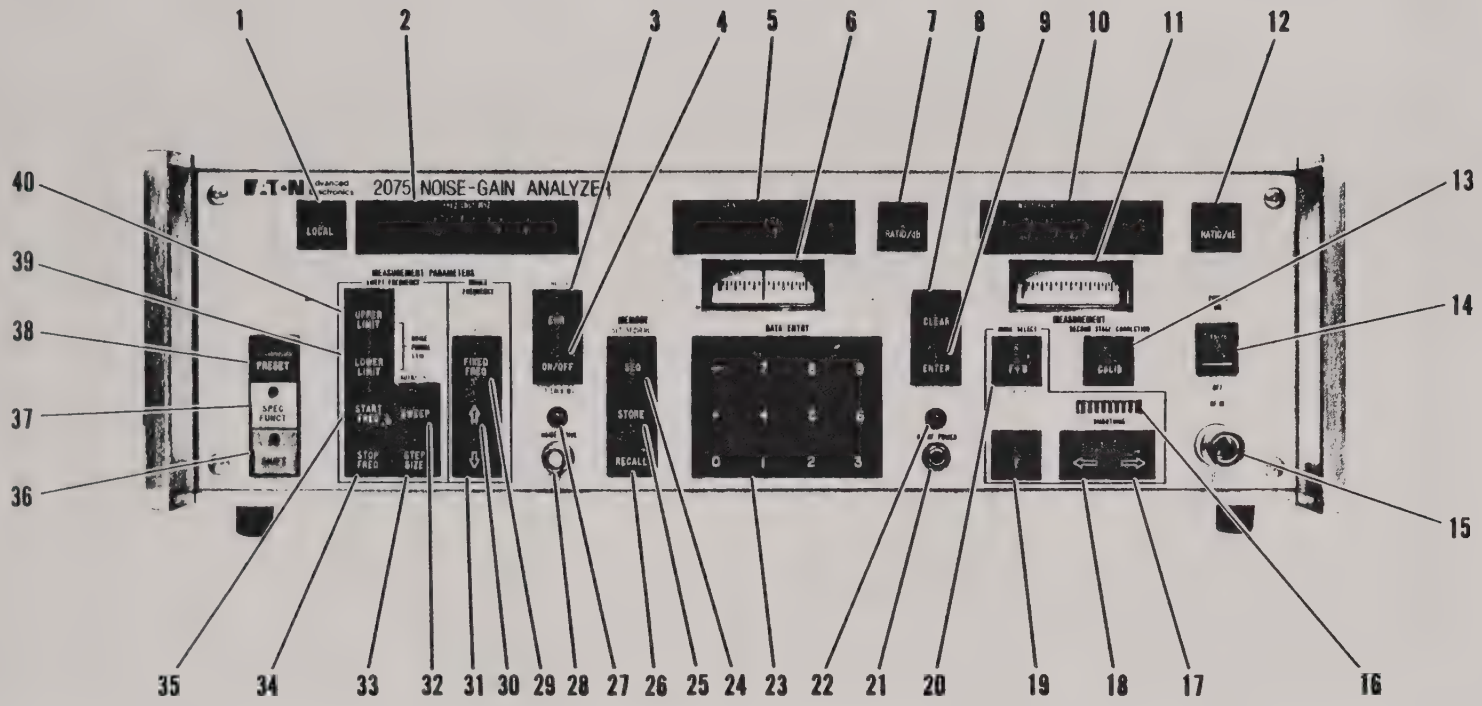


Figure 3-1. Operating Controls, Switches, Indicators and Receptacles, Model 2075, Front View

Section III

CONTROLS, SWITCHES, INDICATORS, AND RECEPTACLES

3.1 INTRODUCTION

This section contains functional descriptions of all controls, switches, indicators, and receptacles for the Model 2075 Noise Gain Analyzer.

3.2 CONTROLS, SWITCHES, INDICATORS, AND RECEPTACLES

All external controls, switches, indicators, and receptacles of the Model 2075 are located on the front and back panels. Their location is identified by numbers in Figures 3-1 and 3-2 and their functions described in Table 3-1. Many of the front panel keys have dual functions and these keys are identified with an asterisk (*) in the second column of Table 3-1 (see REF NO. 36). One of the keys, LOCAL, actually has three functions. Pin data for the GPIB receptacle (REF NO. 46) is given in Table 3-2 and Figure 3-3.

TABLE 3-1. Controls, Switches, Indicators, and Receptacles

REF. NO.	KEY/PANEL MARKING	FUNCTION
1	**	This is the only three function key. In the non-shifted mode, it switches to Local mode (from remote) and if in local, it allows the 2075's GPIB address to be displayed and entered. In the shifted mode, it allows the LO Address to be displayed and entered.
	LOCAL	If the instrument is in remote and is not in LOCAL LOCK OUT mode, then this key returns the instrument to local (front panel) operation when in the remote GPIB mode.
	GPIB ADDR	If the instrument is in Local, this is the Prefix key for displaying and entering the 2075's GPIB address (0 thru 15).
	LO ADDR	Prefix key for displaying and entering the address of the external local oscillator.
2	FREQUENCY (MHZ) (LED Display)	Displays the frequency (MHz) appropriate to the function being performed. The panel also has the following annunciators: SRQ, RMT, TALK, LSTN, LO, IF, RF, ENTER.

TABLE 3-1. Controls, Switches, Indicators, and Receptacles (Cont.)

REF. NO.	KEY/PANEL MARKING	FUNCTION
3	*	Initiates the ENR table entry mode (non SHIFT) and the THOT (K) entry mode (SHIFT).
	ENR	This key must be pressed prior to entering the first of the ENR/FREQ table entries. When all table entries are completed, the key must be pressed to disengage the ENR/FREQ mode. When this function is activated, the key's annunciator lamp is energized.
	THOT(K)	This (shifted) key must be pressed prior to entering the value for THOT(K).
4	*	Initiates non-automatic noise measurements (non SHIFT) and the TCOLD (K) entry mode (SHIFT).
	ON/OFF	Used to trigger a measurement in the manual measurement mode.
	TCOLD(K)	This (shifted) key must be pressed prior to entering the value for TCOLD(K).
5	GAIN (LED Display)	Primarily used to display GAIN and ENR but also displays temperature in Fahrenheit (F) and Centigrade (C) or Kelvin degrees. Both ENR and gain may be displayed as dB (default) or RATIO. ENR must be entered as dB.
6		Analog meter indicator for noise figure measurements.
7	RATIO/dB (for Gain)	Selects the unit of display for the GAIN digital display window. Depressing the key will alternately switch the unit between RATIO and dB. An annunciator in the digital display shows the unit selected.
8	CLEAR	Used to clear all numeric data which has been keyed-in but not terminated with the ENTER key. In ENR mode, this key may be used to clear ENR table entries.
9	ENTER	Used to terminate all numeric data entry functions. Numeric data that is entered does not become permanent (useable) until this key is pressed.

TABLE 3-1. Controls, Switches, Indicators, and Receptacles (Cont.)

REF. NO.	KEY/PANEL MARKING	FUNCTION
10	NOISE FIGURE (LED Display)	Displays F (Noise Figure), Y Factor, Te (effective noise temperature $^{\circ}$ K) and Power (dB). F and Y may be displayed as dB (default) or RATIO.
11		Analog meter indicator for NOISE FIGURE measurement.
12	RATIO/dB (For Noise Figure)	Selects the unit of display for the NOISE FIGURE digital display window. Depressing the key will alternately switch the unit between RATIO and dB. An annunciator shows the unit selected.
13	*	Initiates second-stage calibration (non-SHIFT) and single-frequency calibration (SHIFT).
	CALIB	Used to initiate calibration of the instrument by measuring the second stage noise figure.
	SINGLE FREQUENCY	Used (shifted) to perform a single-frequency calibration at the current tuned frequency and to set the start and stop frequency to this same fixed frequency.
14	POWER ON/OFF	Switch to turn on and turn off the power to the instrument.
15	RF IN	Used to connect the device under test (DUT) to the 2075. The input impedance is 50 ohms nominal. Operating input level is less than -100 dBm. Frequency range at the input is 10 to 1800 MHz.
14	SMOOTHING Indicator	This series of ten LED light bars indicates the degree of smoothing that is currently in effect. The left most position represents two to the power of zero, or a smoothing factor of one. The remaining positions represent two to the power of one thru nine (Range 1 thru 512).
15	SMOOTHING Right Arrow	Used to increment the smoothing factor which is applied to all measured data.
18	SMOOTHING Left Arrow	Used to decrement the smoothing factor which is applied to all measured data.
19	*	Initiates the F measurement mode (non SHIFT) and Te measurement mode (SHIFT). When either function is activated, the key's annunciator lamp is energized.
	F	Used to to make measurement of Uncorrected Noise Figure (Cascade).
	T_e	Used to make measurement of Effective Noise Temperature in degrees Kelvin (uncorrected).

TABLE 3-1. Controls, Switches, Indicators, and Receptacles (Cont.)

REF. NO.	KEY/PANEL MARKING	FUNCTION
20	*	Initiates the F+G measurement mode (non SHIFT) and Te+G measurement mode (SHIFT). When either function is activated, the key's annunciator lamp is energized.
	F + G	Used to make measurement of Second Stage Corrected Noise Figure and Gain
	T_e + G	Used to make measurement of Second Stage Corrected Effective Noise Temperature and Gain.
21	RELAY POWER Output	Voltage supply used to drive an external relay whose contacts are usually wired to bypass the DUT during calibration (CALIB) of the instrument. The voltage is selectable: 5V, 12V, or 30V DC.
22	RELAY POWER Lamp	Lamp to indicate that the relay power supply is energized.
23	DATA ENTRY 0 thru 9 decimal point and minus	Used to enter numeric data related to the various instrument functions. The digits selected are displayed on the digital LED display panels but do not become permanent until the ENTER key has been pressed. Digits which have not been ENTER-ed may be cleared with the CLEAR key.
24	*	Initiates the Sequential mode (non SHIFT) and the Set Sequence mode (SHIFT).
	SEQ	Increments sequentially through the nine memory storage registers (1 thru 9) while displaying the current resister number.
	SET SEQUENCE	Initiates the Set Frequency mode and allows the nine memory storage registers to be programmed in any desired sequence. The default sequence is 1 through 9.
25	STORE	This key initiates the Memory Store mode. It must be pressed prior to storing the instrument's current operating parameters in the selected memory storage register (1 thru 9).
26	RECALL	This key initiates the Memory Recall mode. It must be pressed prior to recalling a previously stored set of operating parameters. Storage registers 0 through 9 are selectable.
27	NOISE DRIVE lamp	Lamp to indicate that the +28 volt supply is energized. This voltage drives the external noise source lamp. A special function synchronizes the lamp with the noise drive voltage. Lamp is off in default mode.

TABLE 3-1. Controls, Switches, Indicators, and Receptacles (Cont.)

REF. NO.	KEY/PANEL MARKING	FUNCTION
28	NOISE DRIVE Output	Supplies the +28 V dc power to energize the external noise source.
29	*	Initiates the Fixed Frequency setting mode (non SHIFT) and the Single Frequency Step Size setting mode (SHIFT).
	FIXED FREQ	This key must be pressed prior to entering the Fixed Frequency for single frequency measurements. The minimum allowable frequency is 10 MHz and the maximum is 1800 MHz.
	STEP SIZE	This (shifted) key must be pressed prior to entering the Step Size for manual frequency increment/decrement. The minimum allowable step size is 1.0 MHz.
30	*	Increments the frequency by the frequency increment (non SHIFT) and initiates the setting of the external LO amplitude (SHIFT).
	Up Arrow	When operating in the fixed frequency mode, this key increments the frequency by the frequency increment. The key may be pressed once for single increments or held down for continuous incrementation. When accessing the ENR/FREQ tables, this key acts as a single step pointer up through the table entries. Also acts as a pointer through the special function table.
	EXT LO AMPL	This (shifted) key must be pressed prior to entering the signal amplitude for the external local oscillator.
31	*	Decrements the frequency by the frequency decrement (non SHIFT) and initiates the setting of the second local oscillator frequency.
	Down Arrow	When operating in the fixed frequency mode, this key decrements the frequency by the frequency increment. The key may be pressed once for single decrements or held down for continuous decrementation. Acts as a pointer down through the ENR/FREQ tables and the special function table.
	SECOND LO FREQ	This (shifted) key must be pressed prior to entering the frequency for the second local oscillator used in DUT Configuration 6.

TABLE 3-1. Controls, Switches, Indicators, and Receptacles (Cont.)

REF. NO.	KEY/PANEL MARKING	FUNCTION
32	*	Initiates the Sweep mode which performs an automatic sweep measurement beginning with the START FREQ and incrementing by the STEP SIZE until the STOP FREQ is reached. In the AUTO SWEEP mode (non SHIFT), the sweeping operation is repeated continuously. In the SINGLE SWEEP mode (SHIFT) the operation is performed only once.
	AUTO SWEEP	
	SINGLE SWEEP	
33	STEP SIZE	Initiates the Sweep Size setting mode. This key must be pressed prior to entering the Step Size for the sweeping operation. The minimum allowable step size. is 1.0 MHz.
34	*	Initiates the Stop Frequency setting mode (non SHIFT) and the LO frequency setting mode (SHIFT).
	STOP FREQ	Initiates the Stop Frequency setting mode. This key must be pressed prior to entering the Stop Frequency of the sweep function. The maximum stop frequency is 1800 MHz.
	LO FREQ	Initiates the LO frequency setting mode. This (shifted) key must be pressed prior to entering the LO frequency.
35	*	Initiates the Start Frequency setting mode (non SHIFT) and the IF frequency setting mode (SHIFT).
	START FREQ	Initiates the Start Frequency setting mode. This key must be pressed prior to entering the Start Frequency of the sweep function. The minimum start frequency is 10 MHz.
	IF FREQ	This (shifted) key must be pressed prior to entering the IF frequency.
36	SHIFT	Modifies the function of a selected subgroup of front panel keys which have both a primary and secondary function. The secondary function of the dual purpose keys is identified with panel lettering (adjacent to the keys) which is the same orange color as the SHIFT key. When this function is activated, the key's annunciator lamp is energized.

TABLE 3-1. Controls, Switches, Indicators, and Receptacles (Cont.)

REF. NO.	KEY/PANEL MARKING	FUNCTION
37	SPEC FUNCT	Initiates the Special Function mode of operation. This key must be pressed prior to entering a special function code. When this function is activated, the key's annunciator lamp is energized.
38	PRESET	Initiates three actions: 1. Saves the instrument's current programmed parameters in memory location zero M(0). 2. Sets the instrument's operating parameters to the nominal values given in Section 5.7.x.
39	*	Initiates the Lower Limit setting mode for both Noise Figure (non SHIFT) and Gain (SHIFT). The limits are used by the oscilloscope/plotter and front panel analog meters.
	LOWER LIMIT NOISE FIGURE	Must be pressed prior to entering the lower limit for Noise Figure. The minimum lower limit for Noise figure is 0 dB.
	LOWER LIMIT GAIN	Must be pressed prior to entering the lower limit for Gain figure. The minimum lower limit for Gain is -20 dB.
40	*	Initiates the Upper Limit setting mode for both Noise Figure (non SHIFT) and Gain (SHIFT). The limits are used to calibrate the oscilloscope/ plotter and front panel analog meters during a sweep operation.
	UPPER LIMIT NOISE FIGURE	Must be pressed prior to entering the upper limit for Noise Figure. The maximum upper limit for Noise Figure is 30 dB.
	UPPER LIMIT GAIN	Must be pressed prior to entering the upper limit for Gain figure. The maximum upper limit for Gain is 65 dB.
41	X	Output to the Oscilloscope/Plotter X axis. This line carries the frequency component of the measurement.

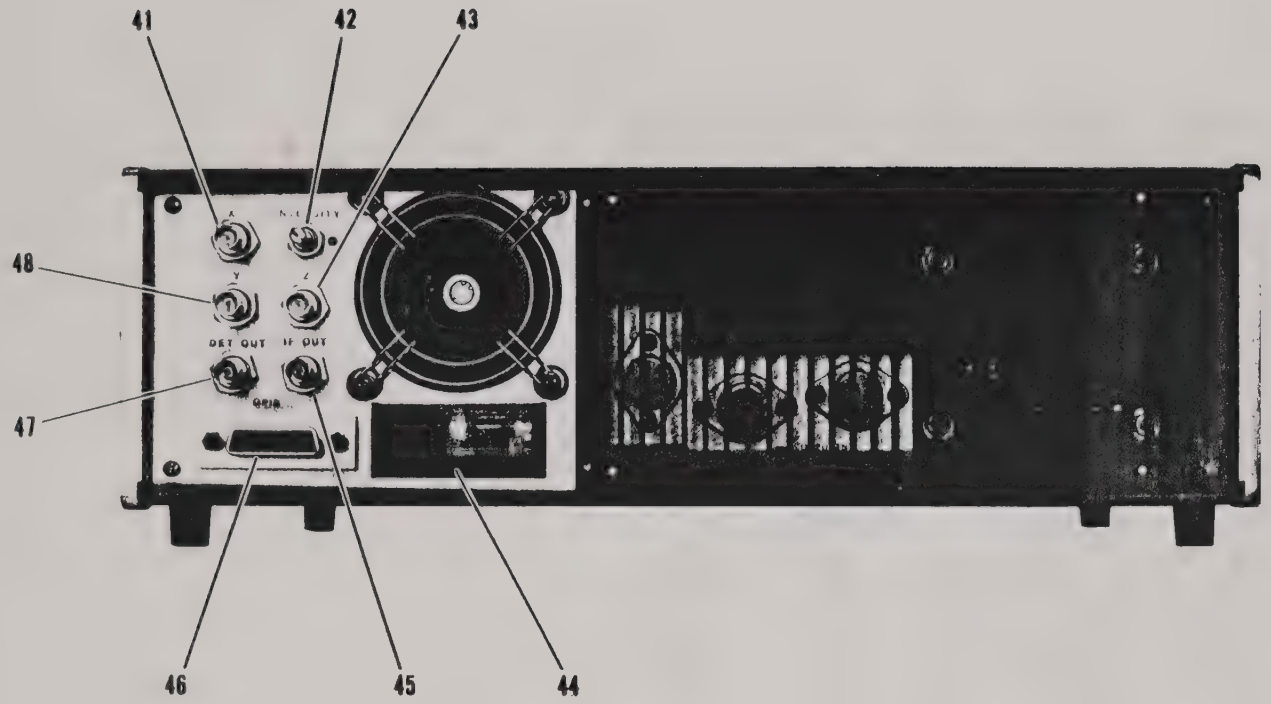


Figure 3-2. Operating Controls and Receptacles, Model 2075, Rear View

TABLE 3-1. Controls, Switches, Indicators, and Receptacles (Cont.)

REF. NO.	KEY/PANEL MARKING	FUNCTION
42	INTENSITY	Intensity modulation Control. Sets the relative brightness level of the two traces (Noise and Gain) on the oscilloscope. The noise trace is the brighter one.
43	Z	Output to Oscilloscope/Plotter Z axis. This line carries the signal to blank the scope while the beam retraces or lifts the pen on the plotter in the plotter mode. It also carries the intensity control voltage for the gain trace.
44	INPUT	AC power input, fuse module, and voltage selector.
45	IF OUT	30 MHz IF Output test point.
46	GPIB	General Purpose Interface Bus connector. Refer to Table 3-2 for pin designations.
47	DET OUT	Detector Output test point.
48	Y	Output to the Oscilloscope/Plotter Y axis. Both Noise and Gain components of the measurement are outputted on the line.

3.3 GPIB CONNECTOR

Figure 3-3 shows the pin layout of the rear-panel GPIB connector. Table 3-2 shows the signals that are associated with each of the 24 pins.

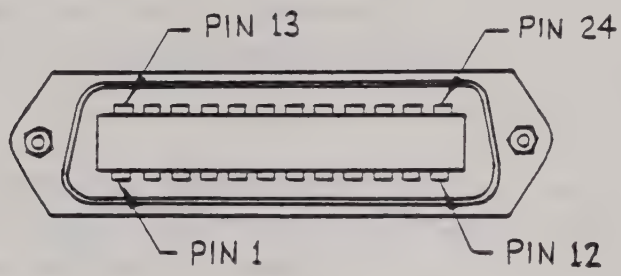


Figure 3-3. GPIB Connector Pin Layout

Table 3-2

GPIB CONNECTIONS			
PIN #	DATA	PIN #	DATA
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EIO	17	REN
6	DAV	18	Signal ground for pin 6
7	NRFD	19	Signal ground for pin 7
8	NDAC	20	Signal ground for pin 8
9	IFC	21	Signal ground for pin 9
10	SRQ	22	Signal ground for pin 10
11	ATN	23	Signal ground for pin 11
12	SHIELD	24	Signal ground for LOGIC

The GPIB Logic Levels are Negative True TTL compatible and conform to IEEE-1978 standards. The true (1) state is 0.0 V dc to +0.8 V dc. The false (0) state is +2.0 V dc to +5.0 V dc. Proper termination provided internally.

The following GPIB connecting cables are available:

1 meter (3.3 feet)	1-998094-001
2 meter (6.6 feet)	1-998094-002
4 meter (13.2 feet)	1-998094-003

The GPIB is limited to a maximum cable length of 4 meters (13.2 feet) for any one instrument, and a total accumulative length of 20 meters (65.6 feet) for multiple instruments.

3.3.1 GPIB Reference Documents

The following documents provide detailed information for the GPIB interface.

IEEE Standard Digital Interface For Programmable Instrumentation.
Document: IEEE STD 488-1978

Getting Aboard The 488-1975 Bus (Motorola)

Section IV

INSTALLATION

4.1 INTRODUCTION

This section contains instructions on preparing the Model 2075 for operation.

4.2 EQUIPMENT SETUP

a. Place the instrument on any convenient flat surface.

b. The instrument is shipped ready to operate on 120 V ac, ±10%, 48 Hz to 66 Hz. For other voltages, refer to Paragraph 4.3.

c. Connect the instrument to the AC voltage source via the rear panel INPUT socket.

d. Move the POWER switch to ON. The instrument is ready for immediate use.

4.3 OPERATION ON 100/220/240 VOLTS

While the instrument is shipped to operate on 120 V ac, it may be modified to operate on 100, 220, or 240 volts as follows:

a. Remove the line cord from the receptacle on the instrument's rear panel

b. Slide the transparent fuse cover sideways to expose the fuse.

c. Pull the Fuse Pull lever out to release the fuse.

d. Remove the fuse.

e. Pull out the four-way voltage selector card.

f. Orient the voltage selector card, such that the desired voltage (as printed on the card) is visible when the card is completely re-inserted back into the receptacle below the fuse.

g. Replace the fuse and be sure the rating is correct. For 100/120 volts use 2.0 A fuse. For 220/240 volts use 1.0 A fuse.

h. Slide the transparent fuse cover back in place.

i. Replace the line cord into the receptacle.

4.4 RF INPUT CONSIDERATIONS

Some care must be taken in controlling the signal level applied to the RF IN input receptacle. The maximum allowable RF signal level is 0.1 watt (+20 dBm) while the DC component must not exceed +50V dc. The input impedance is 50 ohms.

4.5 ENVIRONMENTAL CONSIDERATIONS

4.5.1 Ambient Temperature

The Model 2075 is designed to operate in an ambient temperature range of 0°C to 55°C. Operation outside this range over extended periods of time will result in degradation of electrical performance and even malfunction.

4.5.2 Instrument Housing

To keep the instrument operating within its normal temperature range, it is extremely important that the side ventilation panels and the fan on the rear panel be kept open to the surrounding air. Do not cover these surfaces or restrict free air flow to them.

WARNING

If, for any reason, the instrument is operated with its outer cover removed, it is imperative that the two internal covers also be removed. Failure to do so will result in excessively high temperatures developing around critical component areas causing component failure.

Section V

OPERATION

5.1 INTRODUCTION

This section covers the operating information for the 2075 Noise-Gain Analyzer. Included is both an overview of the operating procedures as well as detailed operating instructions.

5.1.1 Device-Under-Test Configurations

The instrument has six DUT Configurations (measurement modes) available and each may be operated either locally or remotely. Each measurement mode is described individually with detailed operating instructions.

5.1.2 Local Operation

Front panel (local) operation of the instrument is covered in the sections described below. For a quick overview of the operation of the 2075, begin with Section 5.4, Basic Operation Procedures. This section is designed to give the new user an introduction to the features of the 2075.

Section 5.5, Getting Familiar With The 2075, is designed for the new user who wishes to start with some basic hands-on activity and get the feel of the instrument. Users who are already comfortable with noise measurement should skip this section and go directly to Section 5.6.

Section 5.6, Detailed Operating Procedures, provides complete detailed instructions for all of the 2075's features.

5.1.2.1 Turn-On Procedures

Section 5.2 explains the series of activities that are automatically performed when power is applied to the instrument. These activities are primarily tests which verify the operation of the unit's basic functions.

5.1.2.2 Keystroke Formats

Section 5.3 explains the four categories of keystroke sequences that are used to communicate with the 2075 via the front panel.

5.1.2.3 Operating Information Reference Card

The instrument has a plastic pull-out reference card located in a tray below the front panel. It summarizes the special function codes, GPIB codes, error codes, and DUT configuration descriptions with connection diagrams.

5.1.3 Remote Operation

Most of the 2075 functions may be selected to run remotely through the General Purpose Interface Bus (GPIB) or through a computer with GPIB capabilities. In remote operation, the instrument operates in one of three modes: normal talker/listener mode, talk only mode, or controller mode. Section 6 gives complete details for operating the 2075 in normal talker/listener mode and talk only mode. This section covers input and output formats, addressing, the status byte, and service requests. Table 6-1 lists the GPIB codes alphabetically with their corresponding parameter descriptions. Table 5-4 lists the Special Function codes numerically with their corresponding GPIB codes.

In addition to the information described in the previous section, remote operations are discussed in various other appropriate places throughout the manual. The controller mode of the instrument is described throughout Section 5.6, Detailed Operating Procedures. A summary of all GPIB codes and formats is provided on one of the front panel Operating Information Reference Cards. In addition, many examples of program strings appear throughout the Detailed Operating Procedures section.

Typical applications for remote operations are production line test setups where a series of tests are to be run repetitively on amplifiers and other devices.

5.1.4 Operational Tests

These are used by the operator to verify that the main functions of the 2075 are functioning correctly. There are two procedures: Basic Operational Tests and GPIB Operational Tests.

5.1.4.1 Basic Operational Tests

These tests require a noise source, an oscilloscope, and the related inter-connecting cables. The procedures are designed to verify that the basic front panel controlled functions are operating correctly.

5.1.4.2 GPIB Operational Tests

These tests require a GPIB computer controller, a GPIB interface, and the related interconnecting cables. The procedures are designed to check the applicable GPIB messages which are summarized in Table 6-3.

5.2 TURN-ON PROCEDURES

Before the instrument is plugged in for the first time, check that the instrument is set for the correct line voltage and that the fuse has the correct current rating. Refer to Section 4, Installation, for complete detailed instructions.

After the front panel line switch is turned to the POWER ON position, the instrument automatically performs a series of internal checks. Initially, all of the front panel lamps and LED display digits are turned on to verify their operation. Following this test, the front panel displays SELF TEST while a series of five internal tests are automatically performed. These tests check the operation of the Math Processor, RAMS, ROMS, GPIB, and DMAC. On completion of these tests, the instrument performs a frequency calibration.

Refer to Tables 5-3 and 5-4 for details of the instrument status after power up.

5.3 KEYSTROKE FORMATS

Implementing each of the instrument's functions requires a prescribed sequence of keystrokes — either a single keystroke or a series a keystrokes. For ease of operation in multiple keystroke functions, the front panel layout is such that the sequence of keystrokes will always move from left to right across the front panel. The functions can generally be categorized into four groups and some keys fall into more than one group depending on whether they are selected alone or as part of a sequence. The four groups are as follows:

5.3.1 Group 1 — Single Keystroke Functions

Functions requiring only a single keystroke are: LOCAL, Non-Automatic Noise Measurement ON/OFF, RATIO/dB, CALIBration, Smoothing Increase/Decrease, Cascade Noise Figure Measurement (F), Second Stage Corrected Noise Figure and Gain Measurement (F+G), SEQuence, Increase/Decrease Frequency, AUTO SWEEP, and PRESET.

5.3.2 Group 2 — Shift Functions

Functions requiring the SHIFT key to be pressed prior to the function itself are: GPIB ADDRess, T HOT(K) entry, T COLD(K) entry, Te measurement, Te + G measurement, SET SEQUENCE, STEP SIZE, EXT LO AMPL, SECOND LO FREQ, SINGLE SWEEP, IF FREQ, LOCAL OSC, GAIN LOWER LIMIT, GAIN UPPER LIMIT, LO ADDRess, and SINGLE FREQUENCY.

5.3.3 Group 3 — Special Functions

Special Functions are always entered according to the format:

SPEC FUNCT/Code/ENTER

where Code is the Special Function (1.3 for example).

5.3.4 Group 4 — Other Functions

Most of the functions which are not special, are entered according to the format:

Function/Data/ENTER

where Function represents one of the selected function keys (STOP FREQ for example) and Data represents a numeric value selected for the function (1200 for example).

5.3.5 Data Entry

Data that is entered following a function will be interpreted for that function only if it is terminated with the ENTER key. Until the ENTER key is pressed, data that was previously entered remains in effect. After numeric data is entered, the only valid keys are ENTER and CLEAR.

5.4 BASIC OPERATING PROCEDURES

This section provides a brief introduction to the front panel operation of the 2075 Noise-Gain Analyzer. The procedures are designed to give the new user an overview of the basic features of the instrument and do not provide details of all of the instrument's many features. Detailed operating procedures are given in Section 5.6 and an index to that section is provided in Table 5-1.

It is recommended that the new user study this section first before moving on to the detailed operating procedures.

5.4.1 DUT Configurations

The 2075 has six DUT (Device Under Test) Configurations. Configuration 1 is used for RF measurements in the range of 10 to 1800 MHz and requires no additional external equipment other than the noise source. Configurations 2 thru 6 are used for microwave measurements and require an external local oscillator. Configurations 2 and 3 also use an external mixer and in configurations 4 thru 6 the mixer is a part of the DUT. Configuration 6 also use a second mixing stage. A DUT Configuration must be selected prior to performing a calibration or measurement. The basic and default configuration is 1 and this is also selected when the PRESET key is pressed.

5.4.2 Preset Function

The PRESET key is used to restore the instrument's status to a predetermined set of operating parameters. The parameter values are given in Table 5-3.

5.4.3 Fixed Frequency Function

To make a measurement at a fixed frequency, the FIXED FREQ key is used. To increment/decrement the selected frequency, a step size is selected via the STEP SIZE, which is the shifted FIXED FREQ key. The keystroke format for both of these entries is:

Function/Data/ENTER

As an example, to set the measurement frequency to 800 MHz and the step size to 50 MHz, press the following keys in the specified sequence:

FIXED FREQ/800/ENTER

SHIFT/FIXED FREQ/50/ENTER

The up/down arrow keys will then increment/decrement the nominal frequency in steps of 50 MHz.

5.4.4 Sweep Frequency Function

To sweep the measurement frequency from a start frequency to a stop frequency in discrete steps, use the same keystroke format as above but use the START FREQ, STOP FREQ, and STEP SIZE keys. As an example, to set up a sweep from 1000 MHz thru 1800 MHz using a step size of 80 MHz, press the following keys in the specified sequence:

START FREQ/1000/ENTER

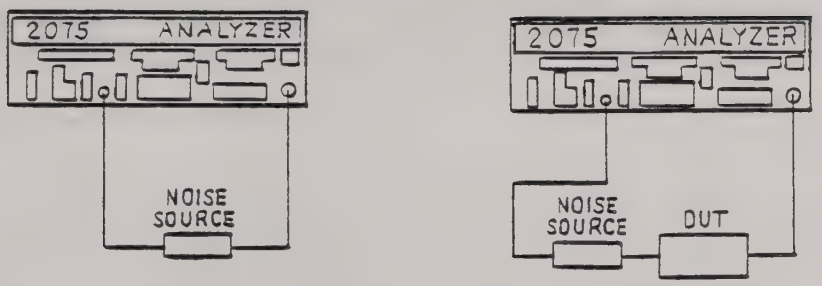
STOP FREQ/1800/ENTER

STEP SIZE/80/ENTER

To initiate continuous sweeping, press SWEEP. To initiate a single sweep, press SHIFT/SWEEP.

5.4.5 Measurement Functions

There are two measurements that can be made by the instrument: Uncorrected Noise Figure and Corrected Noise Figure and Gain. The basic arrangement for making measurements is shown in Figure 5-1.



Calibration Measurement

Figure 5-1. Calibration and Measurement Arrangements.

The noise measurement arrangement may be thought of as having three separate noise components: a noise generator or noise source (NS), the noise of the measurement system itself (2075) — referred to as the second stage noise, and the noise of the device under test (DUT).

5.4.5.1 Noise Source (NS)

The noise source is an accurately calibrated device which, when stimulated by a voltage, continuously generates white (broad band) noise over a known frequency range. The NS device is usually calibrated in terms of ENR (dB) values for a series of discrete frequencies over its operating band. Commercially available noise sources, such as the EATON 7615, have typical average ENR values of around 15 dB operating over a frequency range of 10 MHz to 1500 MHz.

In order to improve the accuracy of noise figure and gain calculations, the NS calibration data is entered into the 2075 and may be stored either as a single (spot) ENR value, or as a table of ENR values covering the device's operating frequency range. It is important to note that prior to making any calibrations or measurements in any of the DUT configurations, the noise source calibration data must first be entered. Detailed information covering this subject will be found in Section 5.6, ENR Tables.

5.4.5.2 Second Stage Noise

Second Stage Noise is the noise of the measurement system, or the instrument itself. The 2075 Noise-Gain Analyzer can measure and store its own noise and gain characteristics. This is accomplished by pressing the CALIB key, which initiates a calibration of the instrument and any other devices connected to the RF IN. When the key is pressed, the 2075 performs a frequency calibration (see Section 5.6, Calibrate) and then goes on to measure its own noise at

each of the calibration points previously selected by the operator. The calibration data is later used to measure gain and perform the "second stage correction" calculations needed to make a Corrected Noise Figure And Gain measurement (F + G).

5.4.5.3 DUT Noise

The noise component of the device under test can be measured in two ways: Uncorrected Noise Figure, and Corrected Noise Figure and Gain. The Uncorrected Noise Figure (Cascade) is the total of the combined DUT noise and second stage noise together; that is, without second stage correction. This figure is displayed when the F key is pressed.

The Corrected Noise Figure and Gain of the DUT is the true measurement of the DUT alone and has the second stage effect eliminated. This figure is displayed when the F+G key is pressed. Since the second stage correction can only be made after the instrument is calibrated, the calibration process must be completed prior to taking a Corrected Noise Figure and Gain reading.

5.4.5.4 Procedure For Corrected-Noise-Figure-and-Gain Measurement

The following steps show the general procedure used to make a Corrected Noise Figure and Gain Measurement for all of the various DUT configurations. The precise procedure will depend on the DUT Configuration that is to be used. The simplest configuration, DUT 1, does not require steps 4 thru 10.

1. Be sure the NS ENR calibration data is entered into 2075.
2. Select the appropriate DUT configuration.
3. Select the measurement frequency parameters (fixed/swept).
4. Select the fixed IF frequency (if required).
5. Select the fixed frequency for the LO (if required).
6. Select the sideband parameter (if required).
7. Select the external LO program (if required).
8. Set the external LO power level (if required).
9. Set the LO settling time (if required).
10. Enable the external LO program (if required).
11. Connect the equipment as shown in Figure 5-1 (CALIBRATE).
12. Calibrate the 2075 by pressing the CALIB key.

13. Insert the DUT as shown in Figure 5-1 (MEASUREMENT).

14. Press SHIFT/SWEEP (single) or SWEEP (continuous).

15. Take a measurement reading.

To make an Uncorrected Noise Figure Measurement, follow the same procedure but skip steps 11 and 12.

It should be noted that during the process of entering the various parameters outlined above, some error messages may appear. While these can usually be ignored, they can be eliminated by selecting Special Function 14.1, Measurement Cycle Pause (Hold Mode), prior to entering the parameters. When all parameters have been entered, the normal status should be restored using Special Function 14.0.

5.4.6 Smoothing Factor

In order to reduce the "jitter" in the displayed Noise and Gain measurements, the 2075 uses a smoothing function with a variable smoothing factor. Minimum smoothing produces maximum "jitter" and vice versa. The smoothing factor is displayed via the front panel LED Light Bar Display.

The smoothing factor is the number of noise figure and gain measurements that are averaged before the results are displayed. Increasing the smoothing factor increases the number of readings that are averaged and also increases the time between readings. As a result, there are less fluctuations in the Noise and Gain readings.

The smoothing factor is decreased/increased with the left arrow/right arrow SMOOTHING keys and is shown on the LED display above the keys.

5.4.7 Store, Recall and Sequence

The 2075 can store (save) the instrument's current front panel configurations for use at a later time. Nine storage registers (1 thru 9) are available for storing up to nine sets of parameters. As an example, to store the current parameters in register 3, press the following keys:

STORE/3/ENTER

To recall these same parameters, press the following keys:

RECALL/3/ENTER

The parameters that can be stored and recalled are shown in Tables 5-3 and 5-4.

5.4.8 Special Functions

The 2075 has many special functions which are accessed with Special Function Codes. These numerical codes have the format XX.X and are entered as follows:

SPEC FUNCT/Code/ENTER

As an example, to implement DUT Configuration 1.3, use Code 1.3.

For detailed information on Special Functions, refer to Section 5.6, Special Functions.

5.5 GETTING FAMILIAR WITH THE 2075

This section is designed to help the new user become acquainted with the basic functions of the 2075. For those who have a working knowledge of the Noise-Gain Analyzer, this section can be skipped.

The following procedures take the user through a series of steps that lead to a simple measurement of the 2075's own noise figure. Proceed sequentially with each step and observe the results.

1. Power-Up Sequence

(a) Energize the 2075 by turning the POWER switch ON.

(b) The unit will automatically execute a series of self tests starting with an LED lamp test. Each LED segment should display an eight (8) and all of the annunciators should be illuminated. Next, the unit performs a series of six digital function checks in which the circuit boards are tested for correct operation. During these six tests, the front panel should display "SELF" on the left side LED panel, "tESt" on the center panel, and 1 thru 6 (sequentially) on the right side panel. Finally, the 2075 performs a frequency calibration (FCAL) which ensures the accuracy of the displayed tuned frequency. While this test is performed, the front panel displays "FCAL" on the center LED panel. This complete series is tests takes only a few seconds.

(c) When the self tests are completed, the 2075 goes to the Uncorrected Noise Figure Measurement Mode and tunes to the frequency that was last programmed into the unit (somewhere between 10 and 1800 MHz). At this point, the left LED panel will show the actual frequency and the right panel will display a random value of noise figure. Note that no valid measurement can take place until a noise source is connected to the 2075.

2. Set Up To Read The 2075's Own Noise Figure

(a) Connect the 2075's NOISE DRIVE output to the input of a suitable noise source (Model 7615 etc.) and connect the output of the noise source to the 2075's RF IN. Notice that the 2075 is displaying a dB Noise Figure reading on the right side display.

(b) To obtain an accurate measurement, the 2075 must first be told the actual ENR value of the noise source that is being used. This information is given on the specification label attached to the noise source (or on a seperate sheet). To enter this calibration data into the 2075, proceed by pressing the following keys:

SPEC FUNCT/5.0/ENTER	Select SF 5.0 (Spot ENR)
ENTER	Prepare to enter ENR spot value

Observe now that the left side displays "ALL" and that the center display shows whatever value of ENR happens to have been previously programmed. The ENTER annunciator should be flashing indicating that the unit is ready to receive the new ENR information. Enter the actual ENR calibration value (dB) on the numeric keypad and then press ENTER. Finally, press the ENR key to terminate the ENR entry mode.

(c) The 2075 should now be measuring its own noise figure and displaying the result on the right side LED panel. This value should be in the range of 5 dB thru 9 dB. The left LED panel will be displaying whatever frequency was last programmed into the unit.

3. Tuning The 2075

(a) Now tune the unit to a specific frequency of 10 MHz by entering the following:

10/ENTER Frequency units are always MHz

Observe that the left LED panel is now showing 10 (MHz) and that the right panel is measuring a noise figure of less than 7 dB. To convert this noise figure into a ratio, press the RATIO/dB key to the right of the NOISE FIGURE display. The reading should now be a ratio of less than 5. To revert back to decibels, press the RATIO/dB key again. This is a toggle function key.

(b) Finally, tune the 2075 to a frequency of 1800 MHz by entering 1800 and then pressing the ENTER key. The noise figure reading should now be less than 9 dB.

5.6 DETAILED OPERATING PROCEDURES

Section 5.6 of the manual contains detailed operating procedures for all of the instrument functions. There is a subsection for each of the functions and these are presented alphabetically.

Table 5-1 lists all of the procedure subsections.

Table 5-1 2075 Detailed Operating Procedures

SUBJECT	PAGE
Bandwidth Compensation	5-13
Calibrate	5-16
Calibration, Frequency	5-18
Calibration, IF Attenuators	5-19
Calibration, Input Gain Selection	5-20
Controlling A GIGA Sweeper	5-21
Creating A User Defined External Local Osc Control Program	5-22
Determining The Bandwidth Ratio Of The DUT And The 2075	5-24
Device-Under-Test (DUT) Configurations	5-27
DUT Configuration 1	5-35
DUT Configuration 2	5-37
DUT Configuration 3	5-40
DUT Configuration 4	5-43
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Fixed Frequency Increments	5-65
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Preset, Power-Up Conditions, and Total System Reset	5-86
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Smoothing Factor	5-89
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Sweep Frequency	5-100
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0.1 MHz Frequency Display Resolution	5-104

BANDWIDTH COMPENSATION

Description

When making corrected noise and gain measurements, it is important to consider the bandwidth of both the Noise-Gain Analyzer and the devices connected to it. The second stage must always have a smaller bandwidth than the DUT. The 2075 has a nominal BW of 4.2 MHz and in most cases this will be narrowest and therefore effective BW of the second stage. In many cases, there will be no devices in cascade with the 2075 other than the DUT, and therefore the 2075 is the second stage. If the DUT BW is less than the second stage BW, then it is necessary to apply bandwidth compensation.

Special Functions 4.1 and 4.2 are used to enter the bandwidth of the DUT (BW1) and the second stage (BW2) respectively. Special Function 4.3 will enable the bandwidth compensation and Special Function 4.0 will disable bandwidth compensation and return the 2075 to normal measurement.

Procedure

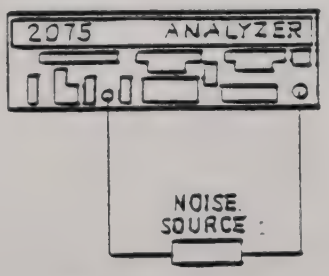
When making a first-stage noise figure measurement, make sure that both bandwidths are programmed to the same value before making a normal second stage calibration. To make a cascade noise figure measurement it is not necessary to do the calibration.

Enter the bandwidth of the second stage (BW2) as follows:

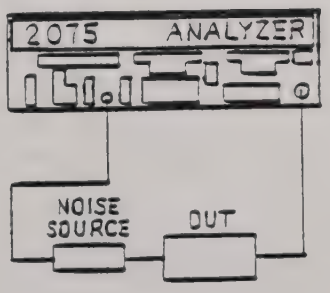
SPEC FUNCT/4.2/ENTER/XX/ENTER

Enter the bandwidth of the DUT (BW1) as follows:

SPEC FUNCT/4.1/ENTER/XX/ENTER



Calibration

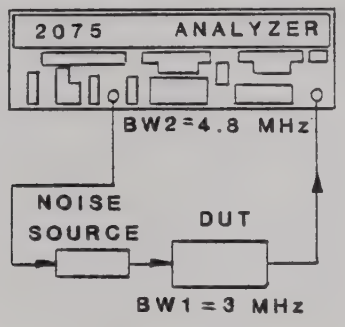


Measurement

Examples

In the following examples, the bandwidth of the DUT is less than that of the second stage, and bandwidth compensation must therefore be applied.

Example 1

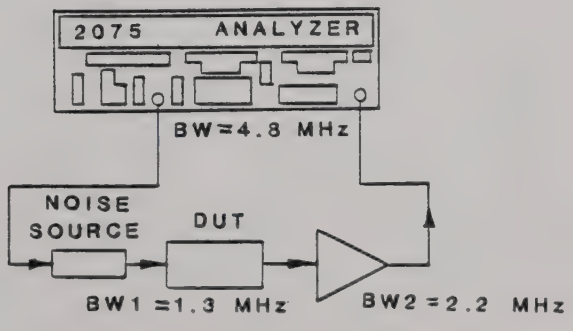


Since BW1 (DUT) is 3.0 MHz and BW2 (second stage) is 4.8 MHz, then the bandwidth compensation is entered as follows:

SPEC FUNCT/4.1/ENTER/3/ENTER

SPEC FUNCT/4.2/ENTER/4.8/ENTER

Example 2

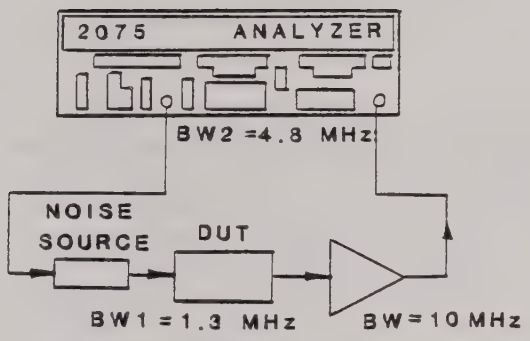


Since BW1 (DUT) is 1.3 MHz and the smallest bandwidth of the second stage (BW2) is 2.2 MHz, then the bandwidth compensation is entered as follows:

SPEC FUNCT/4.1/ENTER/1.3/ENTER

SPEC FUNCT/4.2/ENTER/2.2/ENTER

Example 3



Since BW1 (DUT) is 1.3 MHz and the smallest bandwidth of the second stage (BW2) is 4.8 MHz, then the bandwidth compensation is entered as follows:

SPEC FUNCT/4.1/ENTER/1.3/ENTER

SPEC FUNCT/4.2/ENTER/4.8/ENTER

GPIB Parameters

The GPIB Code for Special Function 4.1 is N1.
Thw GPIB Code for Special Function 4.2 is N2.

Comments

Whenever BW compensation is not required, BW1 and BW2 should be programmed to the same value; the suggested value is 5.0 MHz. When the instrument is shipped from the factory, both bandwidths BW1 and BW2 are set to 5.0 MHz.

Bandwidth compensation is applied only to gain measurement and not to noise figure measurement. If the uncompensated gain of the DUT is greater than 20 dB, its noise figure will be unaffected due to a reduction in bandwidth.

The accuracy of the measurements will depend on how accurately BW1 and BW2 are known. The actual bandwidths should be measured and programmed into the 2075 using Special Functions 4.1 and 4.2. Bandwidth compensation will be correct only if BW1 is less than BW2.

An alternative way of measuring the noise figure and gain of a DUT with a bandwidth which is narrower than the second stage BW, is to add to the second stage a narrow band filter. The BW of the filter must be narrower than the BW of the DUT. Using this method, circumvents the necessity of knowing the precise bandwidths BW1 and BW2. This method establishes the second stage BW as the narrower BW. When this method is used, BW1 and BW2 must be set the same (5.0 MHz). Bandwidth is defined as the 3 dB noise bandwidth.

CALIBRATE

Description

When the CALIB (Calibration) key is pressed, it initiates a calibration of the 2075 and any equipment that is connected to the RF IN. First a frequency calibration (FCAL) is executed and then the noise figure is measured at each of the previously selected frequencies. The noise figure calibration is done over the range from the START FREQ to the STOP FREQ in steps defined by the STEP SIZE. The measured calibration data is used to measure gain and perform the "second stage correction" calculations required to make a Corrected Noise Figure And Gain measurement (F + G). During the calibration procedure, each of the specified frequencies is calibrated at three input gain settings as determined by Special Function 16. The default input gain settings are +25 dB, +10 dB, and -5 dB (Special Function 16.1). For information on other possible gain settings, refer to the subsection "Calibration, Input Gain Selection."

It is important to note, that for accurate measurements of gain and second stage correction, calibration must be performed at the same frequencies that will be used for the measurements. If an attempt is made to measure at a non-calibrated frequency, an error message results. The user may then abort the measurement or use a special function to continue with an interpolated measurement (which may be inaccurate). Any attempt to make a corrected measurement at a frequency less than the START FREQ, or greater than the STOP FREQ, will also result in an error message. No measurement may be made under these conditions.

During the calibration process, the front panel displays the following:

FCAL	during the frequency calibration
CAL1	during calibration at the first input gain setting
CAL2	during calibration at the second input gain setting
CAL3	during calibration at the third input gain setting

Procedure

To start a calibration, press the CALIB key. To terminate a calibration before its normal completion, press the CALIB key again after the FCAL has been completed.

GPIB Parameters

The GPIB Code for Calibration is CA.

Comments

When the calibration is completed, the 2075 automatically goes to the F+G mode.

The calibration cannot be saved using the STORE key and the data is not saved when the instrument is turned off. Calibration must be performed before a second stage corrected noise figure measurement is made..

The calibration process disables all of the front panel keys except CALIB (which is used to abort a calibration).

The maximum number of calibration points is 100. If calibration is attempted with more than 100 points, calibration table overflow occurs and an error message is displayed.

CALIBRATION, FREQUENCY

Description

When the 2075 is powered on, a frequency calibration (FCAL) is automatically performed. Special function codes also allow frequency calibration to be performed automatically at predetermined intervals or on a one time basis. The FCAL procedure ensures the accuracy of the displayed tuned frequency and consists of tuning the first local oscillator (the YIG) to the first IF frequency of 2200 MHz.

The frequency calibration process is initiated by any of the following:

- o The POWER switch is turned ON.
- o The CALIB key is pressed.
- o Special Function 15 is accessed.

Special Function Code 15 operates in the following manner:

Special Function 15.0 starts automatic periodic frequency calibration. This is the normal (and default) mode. After the initial power-on calibration, the FCAL process is repeated after approximately 1 minute, 2 minutes, 4 minutes, 8 minutes, and 16 minutes. Thereafter, FCAL repeats at approximate 16 minute intervals indefinitely.

Special Function 15.1 starts an FCAL immediately. On completion, the instrument returns to the mode that was in effect before 15.1 was initiated.

Special Function 15.2 disables the FCAL operation initiated by 15.0. In this mode, calibration will still take place if the CALIB key is pressed.

Procedure

To initiate a single frequency calibration, press the CALIB key or use Special Function 15.1. To initiate continuous periodic calibrations use Special Function 15.0.

Example

To initiate an immediate frequency calibration, proceed as follows:

SPEC FUNCT/15.1/ENTER

CALIBRATION, IF ATTENUATORS

Description

At approximately six month intervals, the IF Attenuators should be calibrated to compensate for minor shifts in the attenuator values. This is especially true if the instrument is subjected to wide variations in ambient temperature. During this process, the 2075 turns off the power to the noise source and measures each of its four IF attenuators using its own noise power detector. The results of the four measurements are stored internally in non-destructive memory and later used to correct the gain readings. The entire calibration takes only a few seconds. When completed, the 2075 automatically reverts back to the normal operating mode.

Procedure

To Perform an IF Attenuator calibration, disconnect any equipment attached to the front panel RF IN connector and enter Special Function 19.1. The 2075 will then automatically go into a calibration mode and provide front panel status messages during the five step process.

During the five steps, the front panel will display;

Cal 0, Cal 1, Cal 2, Cal 3, Cal 4

Example

Perform an IF Attenuator calibration as follows:

SPEC FUNCT/19.1/ENTER

GPIB Parameters

The GPIB Code for IF Attenuator Calibration is IC.

Comments

The relay power will be enabled during IF Calibration. If external relays are used to bypass the DUT for normal calibration, it is not necessary to disconnect the equipment from the RF input connector.

CALIBRATION, INPUT GAIN SELECTION

Description

During the calibration process, the input gain settings can be selected by choosing the attenuator values. This feature is accessed through Special Function 16. Calibration is performed in the specified frequency range covered by the start frequency through the stop frequency in the step size increments. For each frequency, calibration is completed for the group of three RF attenuator settings selected by the user. There are three such groups of three attenuator settings as shown below. Each group is selectable through a separate special function. The first group, +25 dB, +10 dB, and -5 dB, is also the default group. The gain setting selection depends on the specific application.

Procedure

The three groups of attenuator settings are as follows:

Attenuator Group	Special Function	GPIB Code
+25, +10, and -5 dB	16.1	C0
+10, -5, and -15 db	16.2	C1
-5, -15, and -30 db	16.3	C2

To select a particular set of RF attenuator settings, enter as follows:

SPEC FUNCT/Code/ENTER

where Code is one of the three special function codes.

Example

To select the third group of attenuator settings:

SPEC FUNCT/16.3/ENTER

GPIB Parameters

The GPIB codes related to the special functions are given above.

Comments

Special functions 16.2 and 16.3 are used when calibration through an external amplifier has to be performed. Special Function 16.2 is used for external gain up to 20 dB, while 16.3 is for external gain up to 35 dB.

CONTROLLING A GIGA SWEEPER

Description

This procedure outlines the correct sequence of steps to be followed when controlling a GIGA Sweeper.

Procedure

1. Display/Enter the address of the GIGA Sweeper as follows:

   SHIFT/LOCAL/XXX/ENTER

2. Enable the GIGA Sweeper control program:

   SPEC FUNCT/47.2/ENTER

3. Set the 2075 to controller mode (addressing external LO):

   SPEC FUNCT/40.2/ENTER

4. Display/Enter the GIGA Sweeper minimum frequency. This will tune the sweeper to the specified minimum frequency.

   SPEC FUNCT/10.1/ENTER

   Read the frequency window of the GIGA Sweeper and enter this number into the 2075 as follows:

   XXX/ENTER where XXX = GIGA minimum frequency

5. Display/Enter the GIGA Sweeper maximum frequency. This will tune the sweeper to the specified maximum frequency.

   SPEC FUNCT/10.2/ENTER

   Read the frequency window of the GIGA Sweeper and enter this number into the 2075 as follows:

   XXX/ENTER where XXX = GIGA maximum frequenvy

6. Return to normal measurement:

   SPEC FUNCT/10.0/ENTER

7. The 2075 is now ready to control the sweeper.

CREATING A USER DEFINED EXTERNAL LOCAL OSCILLATOR CONTROL PROGRAM

Description

The 2075 Noise-Gain Analyzer provides control programs for several of the popular local oscillators and these are accessed through Special Functions 47.0 thru 47.3. The instrument also allows the user to define a custom made control program so that the 2075 can interface with other local oscillators. This feature is provided through Special Function 48.1. After the program has been defined, it can be executed using Special Function 47.4.

The custom program is created by modifying an existing 40 byte "scratch pad" which is part of the unit's RAM area. The user's instructions are entered one byte at a time in decimal form for each of the required ASCII characters. As each byte is entered, it is displayed in the FREQUENCY window on the left side of the front panel.

The ASCII characters and their equivalent decimal forms are given in Table 6-4, US ASCII Character Codes. This table is located at the end of the GPIB section.

Procedure

To create a control program, use the following procedure:

1. To access the "scratch pad" for modification, select Special Function 48.1.

2. The first byte of the "scratch pad" will be displayed on the FREQUENCY window. Key in the decimal value for the desired ASCII character and look at the LED display to verify the entry. If correct, press the ENTER key to store the information. If the value is incorrect, press CLEAR and key in the correct value before pressing the ENTER key.

3. After the ENTER key is pressed, the next byte will be displayed. Repeat the previous step until all of the necessary control program information has been entered. A maximum of forty bytes may be entered but the program may be terminated at any time by following step 6.

4. At the point in the program where a frequency parameter should be inserted, enter the decimal value of the ASCII code for CTRL-F. This is a decimal six (6).

5. At the point in the program where the LO amplitude parameter should be inserted, enter the decimal value of the ASCII code for CTRL-A. This is a decimal one (1).

6. When the last control program decimal value has been keyed in and entered, press the ENTER key one more time. The 2075 will return to normal measurement mode.

7. To select the control program, use Special Function 47.4

8. To execute the control program, use Special Function 40.2.

Example

In the following example, assume that a program is required that will control a local oscillator responding to these codes: FQ = fixed frequency, LV = level, MZ = MHz, and DB = dB.

The corresponding ASCII character string and control program decimal values are as follows:

ASCII string —	F	Q	CTL-F	M	Z	L	V	CTL-A	D	B
Decimal value —	70	81	6	77	90	76	86	1	68	66

Key Sequence — 70<E>81<E>6<E>77<E>90<E>76<E>86<E>1<E>68<E>66<E><E>

where <E> represents the ENTER key.

DETERMINING THE BANDWIDTH RATIO OF THE DUT AND THE 2075

Description

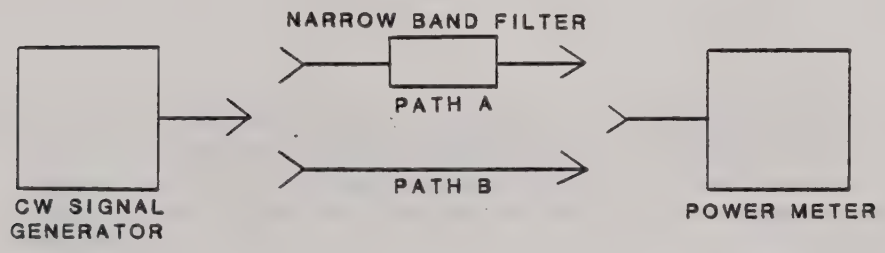
This procedure describes the series of steps required to determine the bandwidth ratio of the DUT and the 2075. The complete procedure is made up of two separate components: measuring the insertion loss of the narrow-band filter, and measuring the noise figure change through the narrow-band filter.

Procedure

Proceed with the following steps:

Measure the insertion loss of the narrow-band filter

1. Connect the filter betwen the signal generator and the power meter as indicated in the following diagram (path A).



2. Tune the CW signal generator to obtain a peak reading on the power meter.

3. Adjust the level of the CW signal generator to set a convenient reference level on the power meter. Note this level.

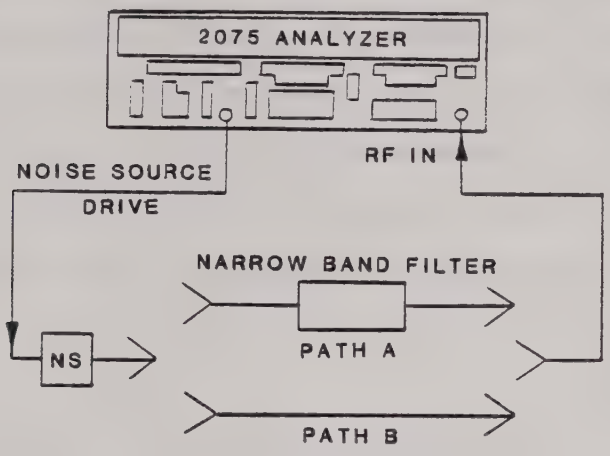
4. Remove the narrow-band filter.

5. Connect the CW signal generator directly to the power meter as shown in path B of the above diagram.

6. Note the change in level on the power meter. The amount of increase over that noted in Step 3 is the insertion loss of the narrow-band filter.

Measure the noise figure change through the narrow-band filter

1. Connect the narrow-band filter between the noise source and the RF INPUT of the 2075 as indicated in the following diagram (path A).



2. Tune the 2075 to the center frequency of the narrow-band filter. The center frequency is the frequency where the lowest noise figure is obtained. Special Function 9.1, 0.1 MHz resolution and 0.1 MHz step size, may be needed to find the exact center frequency.

3. Use adequate smoothing to obtain a steady reading and note the noise figure.

4. Remove the narrow-band filter.

5. Connect the noise source directly to the RF Input of the 2075 (path B).

6. Note the noise figure reading.

Use the following relationships to determine the DUT/2075 bandwidth ratios.

FT = Noise Figure thru the narrow-band filter (Step 3 Diagram 2).

F = Noise Figure of the 2075 only (Step 6 Diagram 2).

L = Insertion Loss of the narrow-band filter (Step 6 Diagram 1).

BL = Bandwidth Loss (loss due to bandwidth reduction).

$$BL = (F+L) - FT \quad \text{(BL is a negative number)}$$

$$\frac{-BL}{10} = R \quad \text{and} \quad 10^{R} = \text{filter/2075 bandwidth ratio}$$

Example

FT = 12 dB
F = 6 dB
L = 3 dB

$BL = (F + L) - FT$
$BL = (6 + 3) - 12 = -3$

$$R = \frac{-BL}{10} = -0.3 \text{ and } 10^{-0.3} = 0.501.$$

The BW of the DUT is half of the 2075 bandwidth.

Comments

The default value of the bandwidths for Special Functions 4.1 and 4.2 is 5.0 MHz. Using the example, the bandwidth value for Special Function 4.1 would be: (.5) (5) = 2.5.

DEVICE-UNDER-TEST (DUT) CONFIGURATIONS

Description

The 2075 has six Device-Under-Test (DUT) configurations:

DUT Configuration 1

This configuration is used for RF measurements in the range of 10 to 1800 MHz and requires no additional external equipment other than the noise source.

DUT Configuration 2

This configuration requires both a variable frequency local oscillator (LO) and an external mixer. Down conversion takes place in the external mixer using a fixed IF.

DUT Configuration 3

This configuration requires a fixed frequency local oscillator and an external mixer. Down conversion takes place in the external mixer using a variable IF.

DUT Configuration 4

This configuration requires a variable frequency local oscillator and down conversion takes place in the DUT using a fixed IF.

DUT Configuration 5

This configuration requires a fixed frequency local oscillator and down conversion takes place in the DUT using a variable IF.

DUT Configuration 6

In this configuration, down conversion takes place both in the DUT, and in an external mixer following the DUT. The DUT is fed from a fixed frequency local oscillator while the external mixer is fed from a variable local oscillator. The IF is fixed.

Configuration Characteristics

Configuration 1 requires no external local oscillator and no mixer. A swept measurement can sweep the 2075's 5 MHz passband over the 10 to 1800 MHz range. Configurations 2 and 4 both require a variable frequency local oscillator and an external mixer, the mixer being the DUT in configuration 4. In either configuration, the 2075 can be used to control the frequency of the external local oscillator as directed by the LO program. The LO can be swept over any band in the 2 to 18 GHz range using the existing LO control programs and the programs can be modified to sweep the LO up to 60 GHz. These frequency limitations are based on the ranges of the external LO and

noise source. Both configurations use a fixed IF and down convert the measurement frequency to the basic 10 to 1800 MHz range of the 2075. The 2075 passband translates into two sidebands, each of which is separated from the LO frequency by a fixed IF (the receiving frequency of the 2075). As the LO frequency sweeps, the sidebands also move together with it. With down conversion in the DUT, configuration 4 is typically used to test mixers and receivers. Configuration 2 down converts in the external mixer and is usually used to test amplifiers and transistors.

Configurations 3 and 5 both require a fixed frequency local oscillator, an external mixer, and a variable IF. The LO can be set to any frequency within the 10 MHz to 60 GHz range. As the variable IF sweeps, the sidebands move away from the LO frequency in opposite directions for an increasing IF sweep, and towards the LO frequency for a decreasing IF sweep. Like the configurations discussed in the previous paragraph, configuration 3 does the down conversion in the external mixer and is usually used to test amplifiers and transistors. Configuration 5 converts in the DUT, and is therefore suitable for testing mixers and receivers.

Configurations 6 uses two stages of down conversion; the first being the DUT itself, and the second stage being an external mixer. The first stage uses a fixed frequency local oscillator and generates a variable IF as input to the second stage. The second stage uses a variable frequency oscillator and produces a fixed IF. Since this configuration uses down conversion in the DUT, it is typically used to test mixers and receivers.

In configuration 1, no sideband selection is needed. In configurations 2 and 4, because of the frequency conversion involved, both Single Sideband and Double Sideband (DSB) may be used. In configurations 3, 5, and 6, a DSB measurement is not valid because the average measurement frequency is the LO frequency and it does not alter as the IF is swept.

The key features of the six configurations are summarized in the following table.

DUT Configuration Characteristics

DUT CONFIGURATION	LOCAL OSCILLATOR	IF	DOWN CONVERSION	SPECIAL FUNCTION	GPIB CODE
1	None	None	None	1.1	D1
2	Variable	Fixed	In external mixer	1.2	D2
3	Fixed	Variable	In external mixer	1.3	D3
4	Variable	Fixed	In DUT	1.4	D4
5	Fixed	Variable	In DUT	1.5	D5
6	a) Fixed b) Variable	Fixed	In DUT and second mixer	1.6	D6

Local Oscillator Interface

In DUT Configurations 2 thru 6, the 2075 controls an external oscillator. In these configuration, there must be a GPIB cable connecting the two instruments. To use the 2075 to control the LO, Special Function 40.2 (external LO control) is used. If this code is used, no other controller may be connected to the bus.

In order to control the LO, the proper LO program must be selected and the 2075 external LO address must match the GPIB external LO address.

Several predefined external LO programs are contained in ROM (permanent):

Control Program	Special Function
HP 8672	47.0
Wiltron 6600 Series	47.1
GIGA Sweeper (European)	47.2
HP 8350A	47.3
User Defined program	47.4

Note that SF 47.4 selects a user defined control program. Before the program can be used, however, it first must be defined by the user. This procedure is covered in the subsection "Creating A User Defined External Local Osc Control Program."

Sideband Selection

Configuration 1 requires no sideband selection. When making a measurement in DUT configurations 2 thru 6, it is necessary to decide which sideband parameter will be selected. Configurations 2 and 4 can operate with either double sideband (DSB), upper sideband (USB), or lower sideband (LSB). Configurations 3, 5, and 6 may use either USB or LSB but not DSB.

Because of the DSB measurement that is made during calibration of DSB modes, the IF frequency should be kept fairly low. Generally, accurate results will be obtained if the IF frequency is kept below 100 MHz.

In LSB modes of operation, sweep operations take longer due to hysterisis compensation in the YIG oscillator.

Special Functions 2.0 thru 2.2 are used to select the sideband parameter.

Display Information

The frequencies shown on the FREQUENCY display of the 2075 for the various DUT configurations and SSB/DSB options are shown in the following table. In DUT Configuration 1, there is no external frequency conversion and the display shows the measurement signal (Fm). In the remaining configurations, conversion is performed, and an external IF is generated. The 2075 is tuned to this IF when the LO is tuned to F_{LO}.

Frequency Display for the DUT Configurations

	DUT Configuration					
Side-Band	1	2	3	4	5	6
Double	Fm	F_{LO}	N/A	F_{LO}	N/A	N/A
Lower	Fm	F_{LO} -IF	F_{LO} -IF	F_{LO} -IF	F_{LO} -IF	F_{LO1} -IF1
Upper	Fm	F_{LO} +IF	F_{LO} +IF	F_{LO} +IF	F_{LO} +IF	F_{LO1} +IF1

Signal Activity

The figures on the following two pages, Figure 5-2, illustrate the signal activity for each of the four groups of DUT configurations.

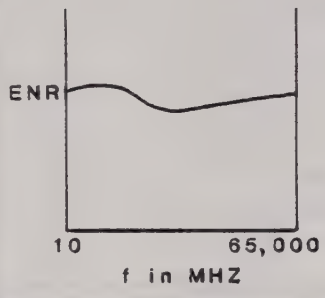
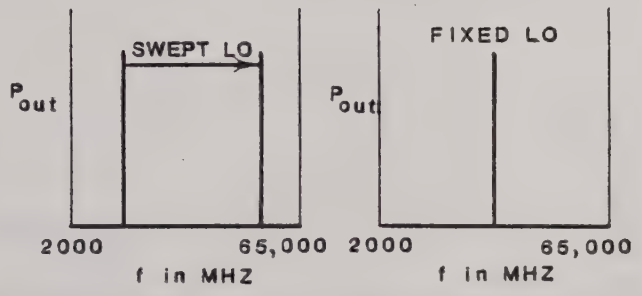
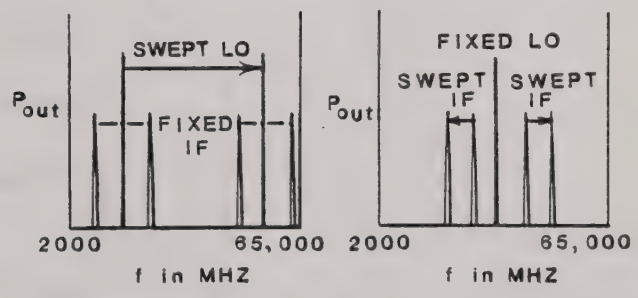
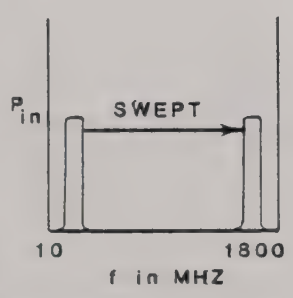
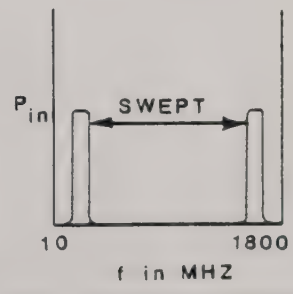
SIGNAL \ MODE	DUT CONFIGURATION		
	1.1	1.2 & 1.4	1.3 & 1.5
	RF	SWEPT LO FIXED IF	FIXED LO SWEPT IF
7626 NOISE SOURCE		SAME	SAME
LOCAL OSCILLATOR	NOT APPLICABLE		
MIXER	NOT APPLICABLE		
2075 INPUT			

Figure 5-2

MODE 1.6 SIGNALS

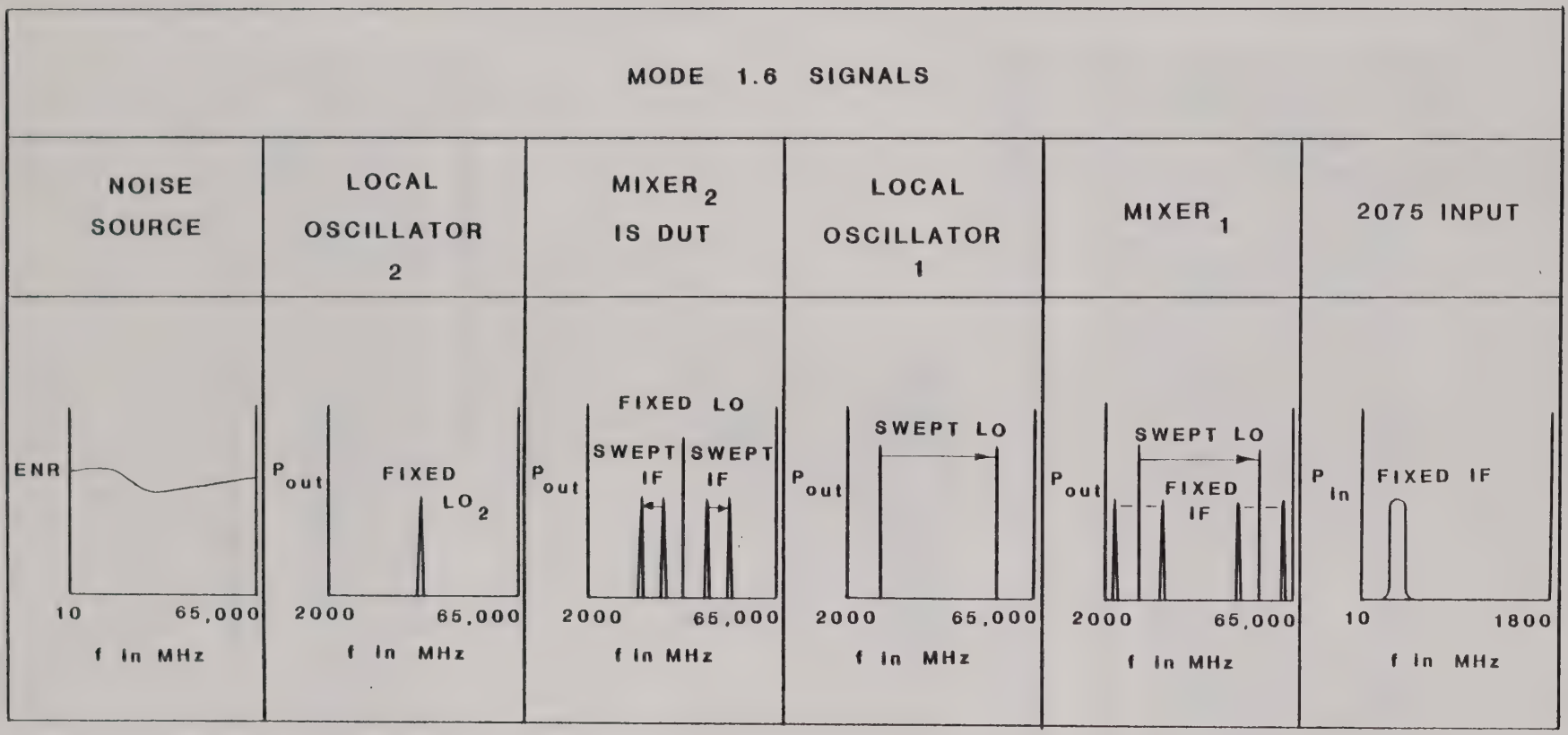


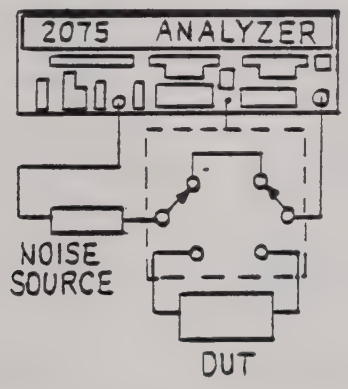
Figure 5-2 (contd)

Relay Driver

Before a Corrected-Noise-Figure-and-Gain measurement can be made in any DUT configuration, it is first necessary to calibrate the instrument with the DUT removed from the circuit. When the calibration is completed, the DUT must be connected back into the circuit and then the measurement can be made. To facilitate the easy disconnection and connection of the DUT, the 2075 provides power to drive an external relay. When a relay is connected to the front panel RELAY POWER outlet, it will be energized whenever the CALIB key is pressed. By wiring the relay contacts to bypass the DUT, the calibration can be completed without the need to manually remove and re-connect the DUT.

The relay voltage can be 5, 12, or 30V dc and is selectable inside the instrument.

The following diagram shows how the relay is connected in a typical DUT configuration.



2075 with relay switching for the DUT

Oscilloscope and Plotter Output

The 2075 can output its noise figure and gain analog information to an oscilloscope, strip chart recorder, or X-Y recorder. The instrument's rear panel has X, Y, and Z outputs which provide the various components of this information. A special test pattern is available to facilitate the correct adjustment of the oscilloscope controls prior to displaying the analog data.

Refer to section 5.6, Oscilloscopes and Recorders To Display Data, for further details.

Special Functions and Keys Related To Setting Up DUT Circuits

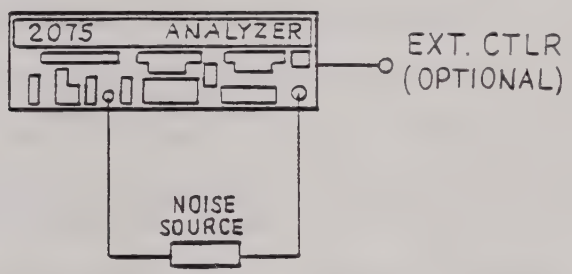
Following are special functions and keystroke sequences used to setup DUT circuits in preparation for making measurements.

Activity	Procedure
Select DUT Configuration 1	SPEC FUNCT/1.1/ENTER
Select DUT Configuration 2	SPEC FUNCT/1.2/ENTER
Select DUT Configuration 3	SPEC FUNCT/1.3/ENTER
Select DUT Configuration 4	SPEC FUNCT/1.4/ENTER
Select DUT Configuration 5	SPEC FUNCT/1.5/ENTER
Select DUT Configuration 6	SPEC FUNCT/1.6/ENTER
Select Double Sideband	SPEC FUNCT/2.0/ENTER
Select Lower Single Sideband	SPEC FUNCT/2.1/ENTER
Select Upper Single Sideband	SPEC FUNCT/2.2/ENTER
Display & enter DUT bandwidth	SPEC FUNCT/4.1/ENTER
Display & enter 2075 bandwidth	SPEC FUNCT/4.2/ENTER
Enable bandwidth compensation	SPEC FUNCT/4.3/ENTER
Enter loss before the DUT (dB)	SPEC FUNCT/18.1/ENTER
Enter DUT temperature before loss	SPEC FUNCT/18.2/ENTER
Enter loss after the DUT (dB)	SPEC FUNCT/18.3/ENTER
Select Start Frequency	START FREQ/XXX/ENTER
Select Stop Frequency	STOP FREQ/XXX/ENTER
Select Step Size	STEP SIZE/XXX/ENTER
Select Fixed IF Frequency	SHIFT/START FREQ/XXX/ENTER
Select Local Oscillator (LO) Freq	SHIFT/STOP FREQ/XXX/ENTER
Select Local Oscillator Amplitude	SHIFT/Up Arrow/XXX/ENTER
Select Second LO Frequency	SHIFT/Down Arrow/XXX/ENTER
Select LO Settle Time	SPEC FUNCT/3.1/ENTER/XXX/ENTER
Select HP 8672 Control Program	SPEC FUNCT/47.0/ENTER
Select Wiltron 6600 Sweeper Pgm	SPEC FUNCT/47.1/ENTER
Select GIGA Sweeper Control Pgm	SPEC FUNCT/47.2/ENTER
Select HP 8350A Control Program	SPEC FUNCT/47.3/ENTER
Select User Defined Program	SPEC FUNCT/47.4/ENTER
Define User Defined Program	SPEC FUNCT/48.1/ENTER

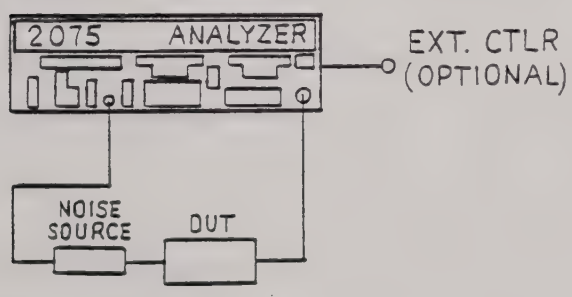
DUT CONFIGURATION 1 (SPECIAL FUNCTION 1.1 GPIB D1)

Equipment Setup

The following diagrams show the method of connecting the instrument for calibration and measurement.



DUT Configuration 1 Calibration



DUT Configuration 1 Measurement

Description

This configuration provides direct measurement of noise figure and gain without the use of an external local oscillator or mixer. The allowable frequency range is the basic range of the instrument; 10 to 1800 MHz.

Procedure

To make a Corrected Noise Figure and Gain measurement, proceed as follows. To make an Uncorrected NF measurement, follow the same procedure but skip steps 4 and 5.

1. Be sure that the noise source ENR calibration data has been entered into the 2075.

2. Select DUT Configuration 1 (Special Function 1.1). This is also the default when the instrument is first turned on or PRESET.

3. Select the measurement frequency parameters (fixed or swept)

4. Connect the equipment as shown in the Calibrate diagram.

5. Calibrate the instrument by pressing the CALIB key.

6. Insert the DUT as shown in the Measurement diagram.

7. If sweeping, press SHIFT/SWEEP (single) or SWEEP (continuous).

8. Take a measurement. If step 5 was completed, the 2075 will be in the F+G mode, otherwise it will be in the F mode.

Note that a sideband parameter is not necessary in this DUT configuration.

Example

To make a Corrected Noise Figure and Gain measurement, sweeping in the range of 10 thru 1800 MHz using steps of 20 MHz, proceed as follows:

1. Enter the DUT configuration (Special Function 1.1):

   SPEC FUNCT/1.1/ENTER

   (GPIB D1)

2. Enter the sweep frequency parameters:

   START FREQ/10/ENTER
   STOP FREQ/1800/ENTER
   STEP SIZE/20/ENTER

   (GPIB FA10MZ FB1800MZ SS21MZ)

3. Connect the NS for calibration and press the CALIB key (GPIB CA).

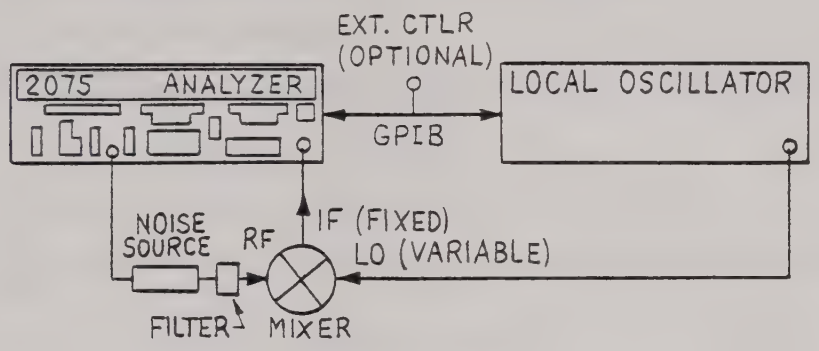
4. Insert the DUT and press SHIFT/SWEEP for a single sweep. For continuous sweeping, press SWEEP.

5. Observe the Corrected Noise Figure and Gain readings.

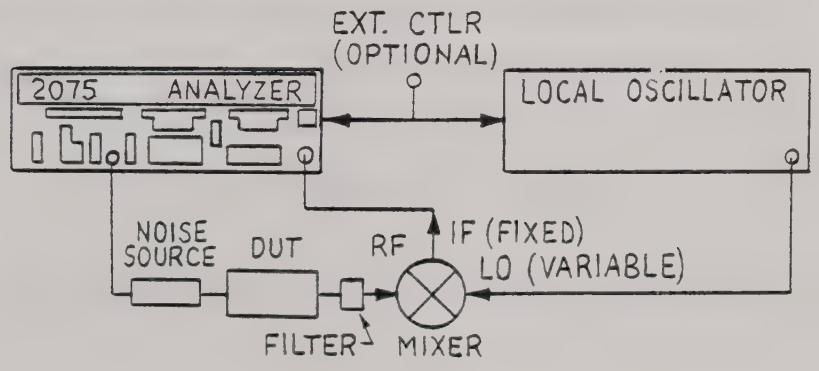
DUT CONFIGURATION 2 (SPECIAL FUNCTION 1.2 GPIB D2)

Equipment Setup

The following diagrams show the method of connecting the instrument for calibration and measurement.



DUT Configuration 2 Calibration



DUT Configuration 2 Measurement

Description

This configuration requires both a variable frequency local oscillator (LO) and an external mixer and provides a means of controlling the LO to obtain a measurement frequency greater than 1800 MHz. Down conversion takes place in the external mixer using a fixed IF frequency. Down conversion cannot take place in the DUT. Typically, the DUT is a transistor or an amplifier.

Procedure

To make a Corrected Noise Figure and Gain measurement, proceed as follows. To make an Uncorrected Noise Figure measurement, follow the same procedure but skip steps 10 and 11.

1. Be sure that the noise source ENR calibration data has been entered into the 2075.

2. Select DUT Configuration 2.

3. Select the measurement frequency parameters (fixed or swept).

4. Select the fixed IF frequency

5. Select the sideband parameter; DSB, USB, or LSB.

6. Select the appropriate program to communicate with the external LO.

7. Set the external LO power level (dBm).

8. Set the LO settling time.

9. Enable the external LO program.

10. Connect the equipment as shown in Calibrate diagram.

11 Calibrate the instrument by pressing the CALIB key.

12. Insert the DUT as shown in the Measurement diagram.

13 If making a swept measurement, press SHIFT/SWEEP (single) or SWEEP (continuous).

14 Take a measurement. If step 9 was completed, the instrument will automatically be in the F+G mode, otherwise it will be in the NF mode.

Example

To make a swept upper sideband (USB) Corrected Noise Figure and Gain measurement, sweeping in the range of 8 thru 12 GHz using steps of 200 MHz with a fixed IF of 80 MHz and using the HP 8672A (at +6 dBm and settling time 20 mSecs), proceed as follows:

1. Enter the DUT configuration (2) (Special Function 1.2):

   SPEC FUNCT/1.2/ENTER

   (GPIB D2)

2. Enter the sweep frequency parameters:

   START FREQ/8000/ENTER

   STOP FREQ/12000/ENTER

   STEP SIZE/200/ENTER

   (GPIB FA8000MZ FB12000MZ SS200MZ)

3. Enter the fixed IF frequency (80 MHz):

   SHIFT/START FREQ/80/ENTER

   (GPIB IF80MZ)

4. Enter the sideband parameter (USB):

   SPEC FUNCT/2.2/ENTER

   (GPIB A2)

5. Select the HP 8672A external LO program:

   SPEC FUNCT/47.0/ENTER

6. Set the LO power level:

   SHIFT/Up Arrow/6/ENTER

7. Set the LO settling time:

   SPEC FUNCT/3.1/ENTER/20/ENTER

8. Enable the HP 8672A external LO program:

   SPEC FUNCT/40.2/ENTER

9. Connect the NS for calibration and press CALIB key (GPIB CA).

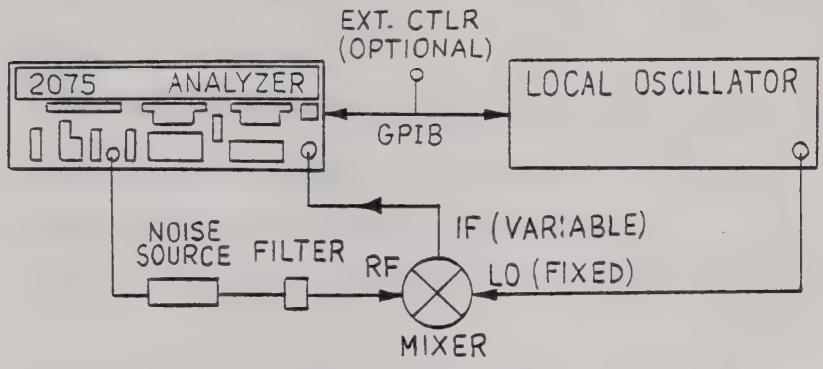
10. Insert the DUT and press SHIFT/SWEEP for a single sweep. For continuous sweeping, press SWEEP.

11. The 2075 will sweep the LO from 8 GHz to 12 GHz in 200 MHz steps. Observe the Corrected Noise Figure and Gain readings.

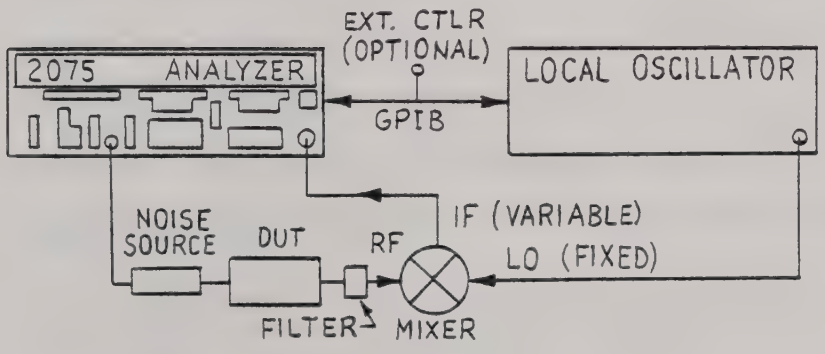
DUT CONFIGURATION 3 (SPECIAL FUNCTION 1.3 GPIB D3)

Equipment Setup

The following diagrams show the method of connecting the instrument for calibration and measurement.



DUT Configuration 3 Calibration



DUT Configuration 3 Measurement

Description

This configuration requires both a fixed frequency local oscillator (LO) and an external mixer. Down conversion takes place in the mixer using a variable IF frequency. Down conversion cannot take place in the DUT. Either upper or lower sideband must be selected (double sideband is not valid) and the unwanted sideband must be filtered out. Typically, the DUT is an amplifier having a bandwidth less than 1800 MHz.

Procedure

To make a Corrected Noise Figure and Gain measurement, proceed as follows. To make an Uncorrected Noise Figure measurement, follow the same procedure but skip steps 10 and 11. Steps 6 thru 9 only apply if the external LO is capable of being controlled by the 2075.

1. Be sure that the noise source ENR calibration data has been entered into the 2075.

2. Select DUT Configuration 3.

3. Select the measurement frequency parameters (fixed or swept).

4. Select the fixed frequency for the LO.

5. Select the sideband parameter; LSB or USB.

6. Select the appropriate program to communicate with the external LO.

7. Set the external LO power level (dBm).

8. Set the LO settling time.

9. Enable the external LO program.

10. Connect the equipment as shown in the Calibrate diagram.

11. Calibrate the instrument by pressing the CALIB key.

12. Insert the DUT as shown in the Measurement diagram.

13 If making a swept measurement, press SHIFT/SWEEP (single) or SWEEP (continuous).

14 Take a measurement. If step 9 was completed, the instrument will automatically be in the F+G mode, otherwise it will be in the NF mode.

Example

To make a swept lower sideband (LSB) Corrected Noise Figure and Gain measurement, sweeping in the range of 6.2 thru 7.6 GHz using steps of 20 MHz and using the HP 8672A (frequency 8 GHz, power +6 dBm, and settling time 20 mSecs), proceed as follows:

1. Enter the DUT configuration (3) (Special Function 1.3):

SPEC FUNCT/1.3/ENTER

(GPIB D3)

2. Enter the sweep frequency parameters:

   START FREQ/6200/ENTER

   STOP FREQ/7600/ENTER

   STEP SIZE/20/ENTER

   (GPIB FA6200MZ FB7600MZ SS20MZ)

3. Enter the external LO frequency (8 GHz):

   SHIFT/STOP FREQ/8000/ENTER

   (GPIB LO8000MZ)

4. Enter the sideband parameter (LSB):

   SPEC FUNCT/2.1/ENTER

   (GPIB A1)

5. Select the HP 8672A external LO program:

   SPEC FUNCT/47.0/ENTER

6. Set the LO power level:

   SHIFT/Up Arrow/6/ENTER

7. Set the LO settling time:

   SPEC FUNCT/3.1/ENTER/20/ENTER

8. Enable the HP 8672A external LO program:

   SPEC FUNCT/40.2/ENTER

9. Connect the NS for calibration and press CALIB key (GPIB CA).

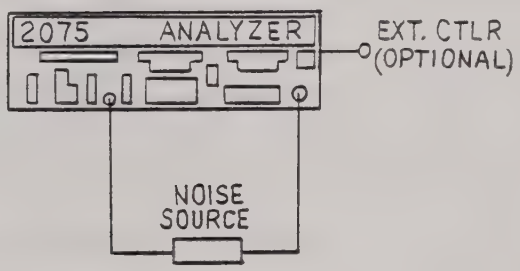
10. Insert the DUT and press SHIFT/SWEEP for a single sweep. For continuous sweeping, press SWEEP.

11. The 2075 will sweep from 1800 to 500 MHz in steps of 20 MHz but will display the actual measurement frequency of 6200 to 7500 MHz. Observe the Corrected Noise Figure and Gain readings.

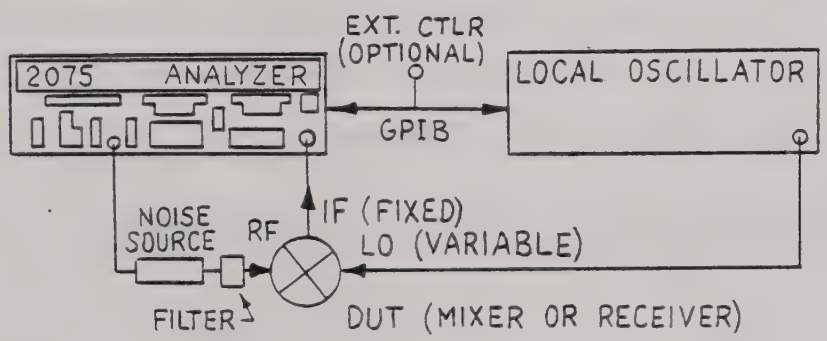
DUT CONFIGURATION 4 (SPECIAL FUNCTION 1.4 GPIB D4)

Equipment Setup

The following diagrams show the method of connecting the instrument for calibration and measurement.



DUT Configuration 4 Calibration



DUT Configuration 4 Measurement

Description

This configuration requires a variable frequency local oscillator (LO) and provides a means of controlling the LO to obtain a measurement frequency greater than 1800 MHz. Down conversion takes place in the DUT using a fixed IF frequency. Typically, the DUT is a mixer or receiver.

Procedure

To make a Corrected Noise Figure and Gain measurement, proceed as follows. To make an Uncorrected Noise Figure measurement, follow the same procedure but skip steps 10 and 11.

1. Be sure that the noise source ENR calibration data has been entered into the 2075.

2. Select DUT Configuration 4.

3. Select the measurement frequency parameters (fixed or swept).

4. Select the fixed IF frequency.

5. Select the sideband parameter; DSB, USB, or LSB.

6. Select the appropriate program to communicate with the external LO.

7. Set the external LO power level(dBm).

8. Set the LO settling time.

9. Enable the external LO program.

10. Connect the equipment as shown in the Calibration diagram.

11. Calibrate the instrument by pressing the CALIB key.

12. Insert the DUT as shown in Measurement diagram.

13. If making a swept measurement, press SHIFT/SWEEP (single) or SWEEP (continuous).

14. Take a measurement. If step 9 was completed, the instrument will automatically be in the F+G mode, otherwise it will be in the NF mode.

Example

To make a swept double sideband (DSB) Corrected Noise Figure and Gain measurement, using an HP 8672A (+6 dBm and settling time 20 mSecs) and sweeping in the range of 6 thru 10 GHz using steps of 100 MHz with a fixed IF of 60 MHz, proceed as follows:

1. Enter the DUT configuration (4) (Special Function 1.4):

   SPEC FUNCT/1.4/ENTER

   (GPIB D4)

2. Enter the sweep frequency parameters:

   START FREQ/6000/ENTER

   STOP FREQ/10000/ENTER

   STEP SIZE/100/ENTER

   (GPIB FA6000MZ FB10000MZ SS100MZ)

3. Enter the fixed IF frequency (60 MHz):

   SHIFT/START FREQ/60/ENTER

   (GPIB IF60MZ)

4. Enter the sideband parameter (DSB):

   SPEC FUNCT/2.0/ENTER

   (GPIB A0)

5. Select the HP 8672A external LO program:

   SPEC FUNCT/47.0/ENTER

6. Set the LO power level:

   SHIFT/Up Arrow/6/ENTER

7. Set the LO settling time:

   SPEC FUNCT/3.1/ENTER/20/ENTER

8. Enable the HP 8672A external LO program:

   SPEC FUNCT/40.2/ENTER

9. Connect the NS for calibration and press CALIB key (GPIB CA).

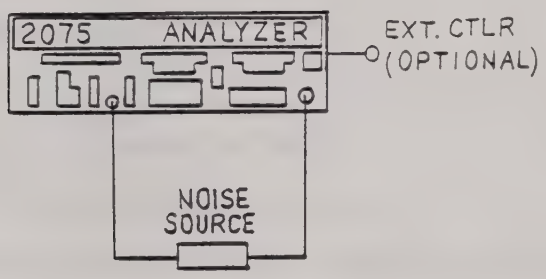
10. Insert the DUT and press SHIFT/SWEEP for a single sweep. For continuous sweeping, press SWEEP.

11. The 2075 will sweep the LO from 6 GHz to 10 GHz in 100 MHz steps. Observe the Corrected Noise Figure and Gain readings.

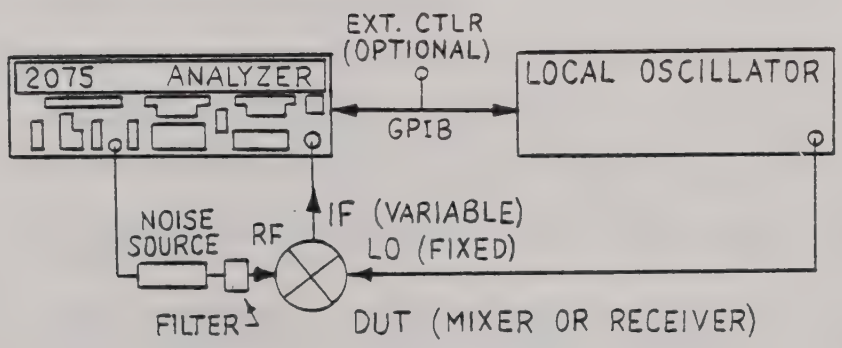
DUT CONFIGURATION 5 (SPECIAL FUNCTION 1.5 GPIB D5)

Equipment Setup

The following diagrams show the method of connecting the instrument for calibration and measurement.



DUT Configuration 5 Calibration



DUT Configuration 5 Measurement

Description

This configuration requires a fixed frequency external local oscillator (LO) and down conversion takes place in the DUT using a variable IF frequency. Typically, the DUT is a mixer or receiver. Either lower or upper sideband may be selected (DSB is not valid) and the unwanted sideband must be filtered out.

Procedure

To make a Corrected Noise Figure and Gain measurement, proceed as follows. To make an Uncorrected Noise Figure measurement, follow the same procedure but skip steps 10 and 11. Steps 6 thru 9 only apply if the external LO is capable of being controlled by the 2075.

1. Be sure that the noise source ENR calibration data has been entered into the 2075.

2. Select DUT Configuration 5.

3. Select the measurement frequency parameters (fixed or swept).

4. Select the fixed frequency for the LO.

5. Select the sideband parameter; LSB or USB.

6. Select the appropriate program to communicate with the external LO

7. Set the external LO power level (dBm).

8. Set the LO settling time:

9. Enable the external LO program.

10. Connect the equipment as shown in Calibration diagram.

11. Calibrate the instrument by pressing the CALIB key.

12. Insert the DUT as shown in the Measurement diagram.

13 If making a swept measurement, press SHIFT/SWEEP (single) or SWEEP (continuous).

14 Take a measurement. If step 9 was completed, the instrument will automatically be in the F+G mode, otherwise it will be in the NF mode.

Example

To make a swept upper sideband (USB) Corrected Noise Figure and Gain measurement, sweeping in the range of 10 MHz thru 1 GHz using steps of 10 MHz and using the HP 8672A (frequency 10 GHz at +6 dBm and settling time 20 mSecs), proceed as follows:

1. Enter the DUT configuration (5) (Special Function 1.5):

SPEC FUNCT/1.5/ENTER

(GPIB D5)

2. Enter the sweep frequency parameters:

   START FREQ/10/ENTER

   STOP FREQ/1000/ENTER

   STEP SIZE/10/ENTER

   (GPIB FA10MZ FB1000MZ SS10MZ)

3. Enter the external LO frequency (10 GHz):

   SHIFT/STOP FREQ/10000/ENTER

   (GPIB LO10000MZ)

4. Enter the sideband parameter (LSB):

   SPEC FUNCT/2.1/ENTER

   (GPIB A1)

5. Select the HP 8672A external LO program:

   SPEC FUNCT/47.0/ENTER

6. Set the external LO power level:

   SHIFT/Up Arrow/6/ENTER

7. Set the LO settling time:

   SPEC FUNCT/3.1/ENTER/20/ENTER

8. Enable the HP 8672A external LO program:

   SPEC FUNCT/40.2/ENTER

9. Connect the NS for calibration and press CALIB key (GPIB CA).

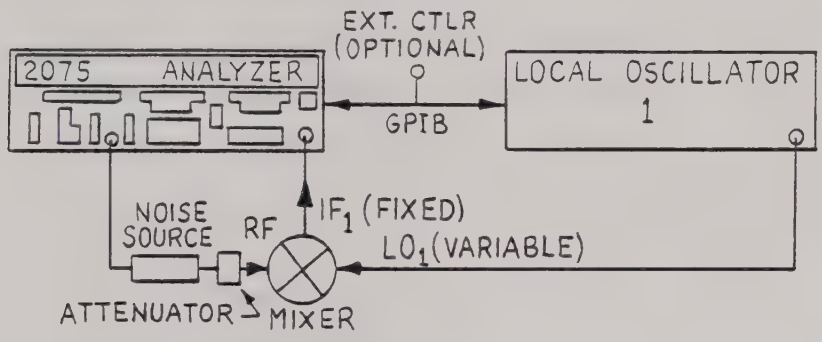
10. Insert the DUT and press SHIFT/SWEEP for a single sweep. For continuous sweeping, press SWEEP.

11. The 2075 will sweep from 10 MHz to 1 GHz in steps of 10 MHz. Observe the Corrected Noise Figure and Gain readings.

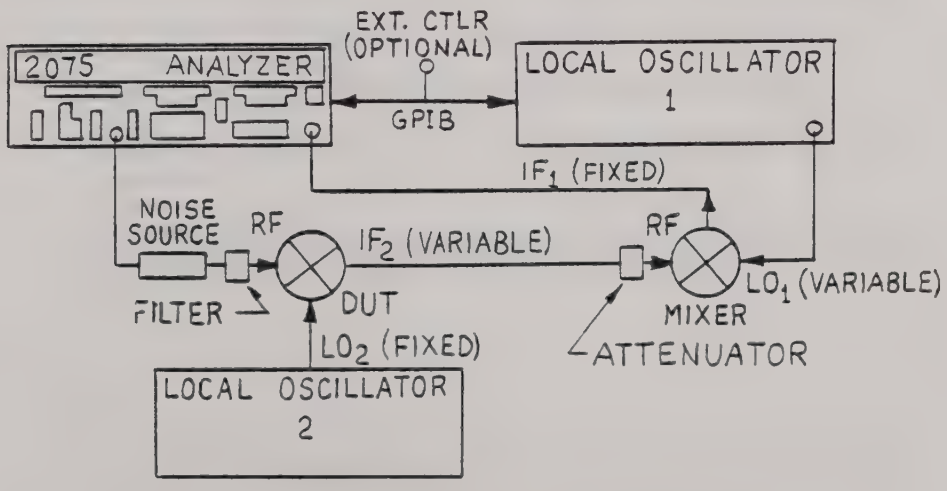
DUT CONFIGURATION 6 (SPECIAL FUNCTION 1.6 GPIB D6)

Equipment Setup

The following diagrams show the method of connecting the instrument for calibration and measurement.



DUT Configuration 6 Calibration



DUT Configuration 6 Measurement

Description

This configuration uses two local oscillators; a variable frequency external LO and a fixed frequency LO. The fixed frequency LO will usually be an integral part of the DUT, but may also be a seperate external LO. The mixer DUT down conversion is beyond the range of the 2075 and so an additional down conversion stage (Mixer + LO1)) is required with a variable frequency. Down conversion takes place in the DUT (mixer) and second mixer and measurement is made using a fixed IF frequency.

Procedure

To make a Corrected Noise Figure and Gain measurement, proceed as follows. To make an Uncorrected Noise Figure measurement, follow the same procedure but skip steps 10 and 11.

1. Be sure that the noise source ENR calibration data has been entered into the 2075.

2. Select DUT Configuration 6.

3. Select the measurement frequency parameters (fixed or swept).

4. Select the fixed frequency for LO2 and IF1.

5. Select the sideband parameter; USB or LSB.

6. Select the appropriate program to communicate with the external LO.

7. Set the external LO1 power level(dBm).

8. Set the LO1 settling time.

9. Enable the external LO1 program.

10. Connect the equipment as shown in the Calibration diagram.

11. Calibrate the instrument by pressing the CALIB key.

12. Insert the DUT as shown in the Measurement diagram.

13. If making a swept measurement, press SHIFT/SWEEP (single) or SWEEP (continuous).

14. Take a measurement. If step 9 was completed, the instrument will automatically be in the F+G mode, otherwise it will be in the NF mode.

Example

To make a swept upper sideband (USB) Corrected Noise Figure and Gain measurement, sweeping in the range of 18 GHz thru 19 GHz using steps of 10 MHz and using the HP 8672A as LO1 (at +6 dBm and settling time 20 mSecs). LO2 is an integral part of the DUT and is set at a frequency of 16 GHz. The IF frequency is 500 MHz. Proceed as follows:

1. Enter the DUT configuration (6) (Special Function 1.6):

   SPEC FUNCT/1.6/ENTER

   (GPIB D6)

2. Enter the sweep frequency parameters:

   START FREQ/18000/ENTER
   STOP FREQ/19000/ENTER
   STEP SIZE/10/ENTER
   (GPIB FA18000MZ FB19000MZ SS10MZ)

3. Enter the frequency for the DUT integral oscillator:

   SHIFT/Down Arrow/16000/ENTER (GPIB SL16000MZ)

4. Enter the fixed IF frequency:

   SHIFT/START FREQ/500/ENTER (GPIB IF500MZ)

5. Enter the sideband parameter (USB):

   SPEC FUNCT/2.2/ENTER (GPIB A2)

6. Select the HP 8672A external LO program:

   SPEC FUNCT/47.0/ENTER

7. Set the external LO power level:

   SHIFT/Up Arrow/6/ENTER

8. Set the LO settling time:

   SPEC FUNCT/3.1/ENTER/20/ENTER (GPIB ST20ET)

9. Enable the HP 8672A external LO program:

   SPEC FUNCT/40.2/ENTER

10. Connect the NS for calibration and press the CALIB key (GPIB CA).

11. Insert the DUT and press SHIFT/SWEEP for a single sweep. For continuous sweeping, press SWEEP).

12. The 2075 will sweep from 18 GHz to 19 GHz in 10 MHz steps. Observe the Corrected Noise Figure and Gain readings.

DISPLAY UNITS

Description

The DUT measurements can be displayed in several different forms or units of measure. The following table shows the various measurement parameters and the associated key functions and GPIB codes. All of these parameters are displayed on the NOISE FIGURE LED display (window C).

Measurement Parameter	Front Panel or Spec Funct	Measurement GPIB Code	Unit Change GPIB Code
NF dB	NF, NF+G or SF 11.0	NF or NG	ND
NF ratio		NF or NG	NG
Y Factor dB	11.1	YF	ND
Y Factor ratio			NG
Operating Noise Temp (K)	11.2	OP	N/A
Power dB	11.3/11.4	PM or PN	ND
Power ratio			NG
Noise measure dB	11.5	NE	ND
Noise meas ratio			NG
Te Kelvin	F (shifted)	TE	N/A
Te + G (K)	F+G (shifted)	TG	N/A

Procedure

The front panel key RATIO/dB, adjacent to the NOISE FIGURE display, is used to toggle between decibel and ratio units of measurement.

The GAIN LED display window shows the gain figures in either decibels or ratio. The RATIO/dB key adjacent to the RATIO display is used to toggle between decibel and ratio units of measurement.

Temperature units, such as T hot and T cold, can be displayed and/or entered in either Kelvin (K), Centigrade (C), or Fahrenheit (F) using SF 12.

To select Effective Noise temperature, Te (Kelvin), as a unit of measurement, press SHIFT followed by the F key. To select Te + G press SHIFT followed by the F+G key.

The default modes are noise figure and dB.

Use Special Function 12 to select temperature units as follows:

Temperature Units	Special Function	GPIB Code
Kelvin	12.0	SK
Centigrade	12.1	SC
Fahrenheit	12.2	SF

Example

To display measured noise as Y Factor in dB, proceed as follows:

SPEC FUNCT/11.1/ENTER

If the measurement is not already displayed as dB, press the RATIO/dB key once.

Comments

The maximum and minimum values for the above units are given in Section 2, Specifications, Table 2-3.

Equations

The equations used to derive the various display units are:

$$Y\ (\text{Ratio}) = \frac{\text{measured power with noise source on}}{\text{measured power with noise source off}}$$

$$Y\ (\text{dB}) = 10 \log Y\ (\text{Ratio})$$

$$F\ (\text{Ratio}) = \frac{\text{ENR (Ratio)}}{Y\ (\text{Ratio}) - 1}$$

$$F\ (\text{dB}) = 10 \log [F\ (\text{Ratio})]$$

$$Te = \frac{T \text{ hot} - Y \times T \text{ cold}}{Y - 1} \qquad M = \frac{(F - 1)}{1 - \frac{1}{G}}$$

T hot = equiv temp of the NS on

T cold = equiv temp of the NS off

G = Gain of DUT in ratio

F = NF of DUT in ratio

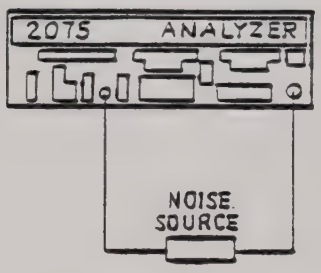
EFFECTIVE NOISE TEMPERATURE (T e) MEASUREMENT

Description

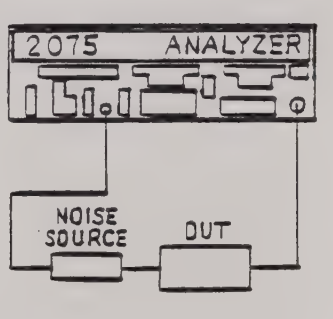
Effective Noise Temperature (T e) is the effective noise temperature of the DUT measured in Kelvins.

Procedure

Connect the DUT as follows:



Calibration



Measurement

To make a cascade T e measurement, press SHIFT/F.

To make a first-stage corrected T e measurement after calibration, press SHIFT/F+G.

The result will be displayed in the NOISE FIGURE window.

GPIB Parameters

The GPIB code for an uncorrected cascade measurement is TE. The GPIB code for a corrected T e + G measurement is TG.

Comments

The formula is as follows:

T e = (F ratio - 1) x 290 (Kelvin)

where F ratio is the noise figure as a ratio.

ENR TABLES

Description

In order to make noise figure measurements, it is necessary to establish the ENR calibration data for the noise source that is to be used. This data is entered and stored via the front panel. When a noise figure measurement is made, the stored information is then accessed and the ENR value obtained for the frequency being used. There are three ways to enter ENR calibration information:

a. Enter a single ENR value which will be used for all measurement frequencies. This value is stored in an ENR calibration register (Table 0) using Special Function 5.0. The 2075 always remembers which of the three ENR tables, if any, was last selected and will automatically use this table when the unit is switched on. If one of the three tables was not previously used, the 2075 will default to Table 0. This table is also the factory selected table. While the register initially contains a value of 15.5 dB, it may be changed to any other value. While this method is acceptable for making measurements at a single frequency, it would not be suitable for making accurate measurements over a wide frequency range.

b. Enter a series of ENR values corresponding to the range of frequencies that are to be used during the tests. These values are stored in an ENR calibration table. There are three such tables which are accessed through Special Functions 5.1 thru 5.3. The table that was last used before the unit is turned off, will automatically be the default table when the unit is next turned on. For measurements at frequencies other than those entered, an interpolation process is used. It is apparent, therefore, that the greater the number of calibration points entered, the greater will be the accuracy of the measurements over the entire frequency range of interest.

c. Use a pre-calibrated ROM ENR table. As an option, many of the EATON noise generators are available with a matching ROM chip containing the associated calibration data. When the chip is installed in the 2075, Special Function 5.4 will allow the calibration table to be accessed.

For the second method, the 2075 allows the entry and display of ENR calibration data for three separate noise sources. The three tables are each capable of accepting up to 31 calibration figures and are supported by nickel cadmium batteries which allow the information to be retained when the machine is turned off.

The valid frequency range for table entries is 10 MHz thru 65.0 GHz. The valid power range for the ENR entries is -7 dB thru +35 dB. If an empty table (no calibration figures) is accessed, an error message is displayed.

Procedure

Changing The ENR Calibration Register Value.

This register is accessed through special function 5.0. To change the ENR Calibration Register value press the following keys:

SPEC FUNCT/5.0/ENTER

ENR/xx.x/ENTER/ENR

where xx.x is the desired ENR value.

Changing the ENR Calibration Table Values.

The three tables (1 thru 3) are accessed through special functions 5.1, 5.2, and 5.3 respectively. To change the contents of a table, proceed as follows:

SPEC FUNCT/5.x/ENTER/ENR

where x is the table number 1 thru 3.

At this point, the flashing annunciators will indicate the type of data that is required. First, the frequency value must be entered followed by ENTER, and then the ENR value must be entered and also followed by ENTER. This completes the first table entry. Repeat the process until all table entries have been completed ... up to 31 maximum.

When all table values have been entered, terminate the process by pressing the ENR key.

Note that table entries do not have to be entered in order of ascending frequency value. Any out-of-sequence entries will automatically be sorted into ascending order.

Example

To enter ENR calibration data into table 1, using the assumed frequency and ENR values, proceed as follows:

```
SPEC FUNCT/5.1/ENTER/
ENR (to enter ENR mode)
10/ENTER/15.50/ENTER
20/ENTER/15.53/ENTER
30/ENTER/15.58/ENTER
          .
          .
          .
1800/ENTER/15.50/ENTER
ENR (to exit ENR mode)
```

Error Correction

If an error is made while entering the numeric values and the ENTER key has not been pressed, simply press the CLEAR key and enter the correct value.

If the error is detected after the ENTER key has been pressed, then press the up arrow/down arrow keys to return to the erroneous entry. If a frequency value is to be eliminated, press CLEAR and the display will go to the next higher frequency. If the ENR is incorrect, enter the correct value and press ENTER. The flashing annunciators always indicate what is currently accessible --- either the frequency or the ENR value. To change from one to the other press the ENTER key.

To clear an entire ENR table immediately, press SHIFT/CLEAR while in the ENR mode.

ERROR MESSAGES

Description

The 2075 generates error messages to provide the user with information concerning incorrect keyboard entries, operating problems, and hardware errors. There are two basic categories of error messages; Transitory and Continuous (or Regenerative).

Transitory messages are displayed for approximately two seconds and then the instrument reverts back to normal activities. These messages usually relate to the denial of some illegal request on the part of the operator.

Continuous messages remain displayed until the error condition is corrected and the system can function normally.

The error messages are also divided into ten groups as follows:

10X Series	ENR table errors
11X Series	Calibration errors
12X Series	Special Function errors
13X Series	Range errors
14X Series	RF Hardware errors
15X Series	Digital Hardware errors
16X Series	GPIB errors
17X Series	Measurement Data errors (GPIB)
505	System error
9XX Series	System errors

All messages within a particular group will begin with the same two digits — 101, 102, 103, for example.

When an error occurs, the front panel displays "Err XXX" where XXX is the actual message number.

The following table (5-2) lists all of the error codes, their meaning, and the necessary corrective action.

Table 5-2 ERROR CODES

ERROR CODE	MEANING	CORRECTIVE ACTION
101	ENR table does not exist	Use special functions 5.0 - 5.4 only.
102	Attempt to modify ENR ROM table	Only tables from 5.1 - 5.3 can be modified.
103	ENR table overflow - more than 31 points entered	Enter no more than 31 calibration points in the table.
104	ENR table empty - no calibration data	Enter ENR data in the table before using it.
105	Frequency too low	Increase the frequency so that it is not lower than the lowest ENR table frequency.
106	Frequency too high	Decrease the frequency so that it is not higher than the highest ENR table frequency.
107	ENR value greater than 18 dB	Only use ENR value greater than 18 dB with proper loss compensation.
110	Measurement at non-calibrated point	Use 24.1 to override but result will be inaccurate.
111	Frequency lower than calibration table	Increase the frequency so that it is within the second stage calibration range or re-calibrate.
112	Frequency higher than calibration table	Decrease the frequency so that it is within the second stage calibration range or re-calibrate.
113	IF attenuator not calibrated or data is wrong	Use special function 19.1 to recalibrate.
114	Cannot find peak during frequency calibration	Try again using special function 15.1 Repeated failure means hardware problem.
115	Calibration data not available	Do second stage calibration before attempting a noise figure plus gain measurement.
116	Calibration error, uncalibrated RF range	DUT gain is greater than 2075's ability to measure. Reduce gain of DUT or measure noise figure only.
117	Calibration table overflow - more than 100 points	Calibrate with 100 or less points (Use narrower frequency range or larger step size).

Table 5-2 ERROR CODES (Cont.)

ERROR CODE	MEANING	CORRECTIVE ACTION
118	Calibration error, due to RF overload.	Select different range using SF 16 or check the hardware.
119	Cannot start a frequency calibration	Try again using special function 15.1. Repeated failure means hardware problem.
121	Special function does not exist	Use valid special function.
122	Sequence not stored	Use set sequence procedure to set the sequence before using this feature.
123	DUT Configuration has conflicting parameters	Check parameters and try again.
124	Invalid to plot gain-only while in F-only mode	Check parameters and try again.
131	Frequency range error (Stop frequency is smaller than start frequency)	Enter appropriate frequencies.
133	The IF tuning frequency is beyond 10 to 1800 MHz	Check the DUT configuration.
134	The external LO frequency is out of range	Check the RF and IF combination.
141	RF overload (RF input too high)	Reduce the RF input power.
143	Detector overload (unable to attenuate the detector to proper level)	May have hardware problem.
151	Battery backup RAM error - data may be lost	Re-enter 2075 GPIB address and ENR table data. Perform IF CAL. Check to see if battery is OK.
152	RAM board error	Check board using SF 32.1.
153	ROM board error	Check board using SF 33.x.

Table 5-2 ERROR CODES (Cont.)

ERROR CODE	MEANING	CORRECTIVE ACTION
154	GPIB board error	Check board using SF 34.2.
155	DMAC board error	Check board using SF 34.1.
156	Scope RAM error	Check board using SF 32.3.
157	A/D converter error	Use Spec Funct 20.1/20.2 to investigate.
158	Math processor error	Check board using SF 34.3.
166	Illegal GPIB mode	Conflict between DUT configurtn and GPIB mode.
170	Measured data is out of range	Check measurement setup.
171	Data not available	The requested data is not available in this mode.
505	System Error	Check power supply voltage: +5 to +5.25 volts. If OK and errors persist, then instrument requires service.
901	System Error	
910	System Error	" "
911	System Error	" "
912	System Error	" "
913	System Error	" "
914	System Error	" "
920	System Error	" "

EXTERNAL CONTROLLER TO MAKE MICROWAVE DUT MEASUREMENTS

Description

If an external controller is available, it may be used instead of the 2075 to control the activities related to DUT measurements.

The following procedures assume that the user has a working knowledge of the IEEE 488 specifications and is familiar with the GPIB requirements and capabilities of the 2075 Noise-Gain Analyzer. It is further assumed that a GPIB compatible external local oscillator is available.

Procedure

The following procedures, which apply to microwave DUT Configurations 2 thru 6, are made up of two major sections: Calibration Procedure and Measurement Procedure.

Calibration Procedure

The following general steps are for calibrating the 2075.

1. Enter the noise source ENR calibration data.
2. Select the required DUT configuration.
3. Select the measurement frequency parameters (fixed or swept).
4. Select the fixed IF frequency (DUT's 2, 4, and 6) or the fixed LO frequency (DUT's 3 and 5). If using DUT 6 also select the second LO fixed frequency.
5. Select the appropriate sideband parameter; DSB, USB, or LSB.
6. Program the external local oscillator frequency and power level. Refer to the GPIB instructions for the particular local oscillator being used.
7. Send GPIB Code T0 (normal continuous measurement).
8. Send GPIB Code RC (SRQ on calibration complete).
9. Send GPIB Code CA (calibrate). Prior to sending this command, be sure the instrument is connected for calibration -- use either the manual setup or the relay driven operation.
10. The 2075 will send an SRQ upon completion of calibration.

Measurement Procedure

This procedure applies to making measurements for DUT configurations 2 thru 6.

1. Set up the required GPIB output format (GPIB Codes F0 thru F6).

2. Tune the 2075 to the desired RF frequency and the external LO to the desired frequency. If using a fixed frequency LO, be sure to tell the 2075 what the external LO frequency is.

3. Send GPIB Code RA (SRQ on data ready).

4. Upon receiving an SRQ, the data is ready to be read. Note: always follow the correct serial poll procedures before reading data.

The 2075 will execute a measurement cycle producing smooth data for the smoothing factor selected. When the data is ready, the 2075 will send an SRQ to the controller and will cease measuring until a serial poll is conducted and the measurement data is read from the 2075 by the controller. After the last data point is read, if another SRQ is not required, the SRQ capability must be disabled prior to reading the data. This is accomplished by sending GPIB code NA.

FIXED FREQUENCY INCREMENTS

Description

When operating in the fixed frequency mode, the operating frequency can be changed using the STEP SIZE (SHIFT/FIXED FREQ) and Up and Down Arrow keys. The STEP SIZE is used to set the fixed increment size and the arrow keys step the fixed frequency up and down by the increment size.

For all DUT Configurations except #1, the allowable frequency increment range is 1.0 thru 1790 MHz. For DUT Configuration 1, the range is 0.1 thru 1790 MHz. An illegal frequency entry will result in an error message.

Procedure

To modify the frequency increment step size, proceed as follows:

SHIFT/FIXED FREQ/XX/ENTER

where XX is the required step size.

To increment/decrement the frequency by the step size press the up/down arrow keys. Holding down either of the arrow keys causes the frequency to step continuously until the limit is reached.

Example

To set the frequency increment to 30 MHz:

SHIFT/FIXED FREQ/30/ENTER

GPIB Parameters

There are no GPIB Codes related to fixed frequency increments.

Comments

Increment step sizes should be entered in integer values of MHz. If a decimal entry is made, the 2075 will round off to the nearest whole MHz.

FIXED FREQUENCY TUNING

Description

The FIXED FREQ key is used to display the frequency to which the 2075 is currently tuned to and to enter a new value of fixed frequency. In DUT Configuration 1, the allowable frequency range is 10 thru 1800 MHz. In DUT Configurations 2 thru 6, the allowable range is 1 MHz thru 65 GHz.

The 2075's tuned fixed frequency can also be modified by using the STEP SIZE (SHIFT/FIXED FREQ) and up and down arrow keys. The STEP SIZE sets the increment size and the up/down arrow keys increment/decrement the fixed frequency by the increment size.

Procedure

To display the 2075's current tuned frequency and enter a new value of tuned frequency, press the FIXED FREQ key, enter the new frequency value and press the ENTER key.

Example

To tune the 2075 to a fixed frequency of 150 MHz, proceed as follows:

FIXED FREQ/150/ENTER

GPIB Parameters

The GPIB Code for this function is FF.

Comments

Fixed frequency values should be entered in integer values of MHz. If a decimal entry is made, the 2075 will round off to the nearest whole MHz.

GAIN MEASUREMENT RANGE

Description

While the 2075 specifications (Section 2) list the gain range as -20 to >+50 dB, this maximum gain figure is actually a worst case situation assuming a DUT bandwidth of greater than or equal to 1800 MHz.

The 2075 is actually capable of measuring gains of much greater than 50 dB depending on the bandwidth of the DUT being measured. If the DUT bandwidth is reduced to 180 MHz, for example, the 2075 could actually measure greater than 60 dB of gain. Reducing the bandwidth of the DUT to 18 MHz would further increase the available gain range up 70 dB or greater.

The total gain measurement range of the 2075 can be expressed as a function of bandwidth ratios as follows:

$$10 \text{ Log } \left[\frac{1800}{\text{BW of DUT}} \right] + 50 = \text{Gain Measurement Range (dB)}$$

LOSS COMPENSATION

Description

The instrument provides a means for compensating for the known losses between the noise source and the device under test (Loss 1), and the losses between the DUT and the 2075 Noise-Gain Analyzer (Loss 2). Such losses might typically be due to the cables connecting the DUT to both the noise source and the instrument. Loss compensation after the DUT is only used when making second-stage corrected measurements.

Loss 1 and Loss 2 must be entered into the instrument along with the temperature of the losses, before the loss compensation function can be effective. Loss 1 and 2 are assumed to have the same temperature and this is the ambient temperature. The temperature can be entered in Kelvins, degrees Fahrenheit, or degrees Centigrade. If no values are entered, default values of 0 dB for the losses and 296.5K for the temperature are assumed.

Procedure

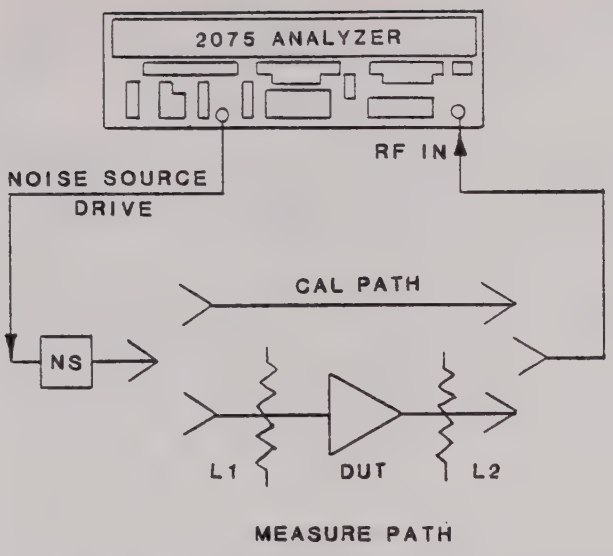
Special Functions 17 and 18 are used to enter the loss compensation parameters. The following table shows the various functions:

Description	SF Code	GPIB Code
No Loss Compensation (OFF)	17.0	NS
Use Loss Compensation (ON)	17.1	LC
Enter Loss 1 (between NS and DUT	18.1	L1
Enter Temperature of Loss 1 and 2	18.2	L2
Enter Loss 2 (between DUT and 2075)	18.3	L3

After the loss compensation parameters have been entered, all subsequent measurements will automatically use these programmed values. Special Function 17.0 will turn off loss compensation and restore the instrument to the basic measurement mode.

Example

Assume it is desired to measure the noise figure and gain of an amplifier which has a loss of 3.03 dB in series with its input and 6.11 dB in series with its output. Assume also that it is impossible to seperate the losses from the DUT itself. The band of interest is 100 MHz thru 200 MHz using a step size of 10 MHz. The noise source ENR is 15.5 dB in this range. T cold is 298.0 K (room temperature) and the losses are also assumed to be at this temperature. The DUT and losses are represented by L1, L2, and DUT on the following diagram:



1. Set up for calibration as shown by the diagram "cal path."

2. Enter ENR, Start/Stop Frequency, Step Size and T cold.

   SPEC FUNCT/5.0/ENTER/ENR/15.5/ENTER/ENR
   START FREQ/100/ENTER
   STOP FREQ/200/ENTER
   STEP SIZE/10/ENTER
   SHIFT/(ON/OFF)/298.0/ENTER

3. Enter Loss 1, Loss Temperature, and Loss 2.

   SPEC FUNCT/17.1/ENTER (turn on loss compensation)
   SPEC FUNCT/18.1/ENTER/3.03/ENTER (loss 1)
   SPEC FUNCT/18.2/ENTER/298.0/ENTER (loss temperature)
   SPEC FUNCT/18.3/ENTER/6.11/ENTER (loss 2)

4. Perform a second-stage calibration by pressing the CALIB key. Note that the instrument automatically performs the calibration without loss compensation. It is, therefore, not necessary to turn off loss compensation during calibration.

5. When calibration is complete, observe the Gain and Noise Figure readings. In this example, the NF reading is blank and the Gain = +9.04 dB.

6. Insert the DUT into the circuit as shown by the diagram "measure path" and tune the 2075 to 150 MHz:

   FIXED FREQ/150/ENTER

7. Observe the readings. In this example, NF = +3.89 dB and G = +22.10 dB. These are true noise figure and gain readings. The 2075 has automatically corrected for the losses L1 and L2.

8. To demonstrate the difference between using and not using loss compensation, turn loss compensation off (SF 17.0) and again observe the readings. This time NF = +6.99 dB and G = +12.96 dB. Now turn loss compensation back on (SF 17.1) and display the corrected value of ENR that is currently being used by entering SF 13.1. The displayed value is 12.47 dB and this represents the original ENR value after automatic compensation for loss L1.

9. Note that the difference between the original ENR value (15.5 dB) and the compensated value (12.47 dB) is 3.03 dB which is equal to the loss L1.

GPIB Parameters

The related GPIB codes are given in the above table.

Comments

It should be noted that Losses 1 and 2 may be positive or negative. A negative loss equates to a gain. To enter a negative loss, simply enter a minus (-) sign ahead of the loss value (dB). This is useful in DUT configurations 2 thru 6 when a SSB measurement is desired but practical filtering of the undesired SB is difficult or impossible. To compensate for the unwanted SB, assuming both SB's are equal, enter a loss of -3 dB. When loss compensation is turned on, this will correct the measurement as if the correct filtering of the SB were achieved.

Loss compensation is automatically de-activated during second stage calibration but always active during noise figure and noise figure + gain measurements as long as Special Function 17.1 is active.

MANUAL MEASUREMENT

Description

The manual measurement functions of the 2075 allow the calibration and measurement of noise figure using a thermal (hot/cold) noise source such as the Ailtech 7009. Manual measurements can only be made at fixed frequencies.

Procedure

Following is the procedure for performing a calibrated manual measurement. To perform an uncalibrated manual measurement, skip steps 8 thru 11.

1. Press the SHIFT key followed by the ENR key to display and enter the T hot temperature in Kelvin. The power-up, PRESET, and total reset default value is 9893 K.

2. Enter the T hot value for the noise source to be used.

3. Press the SHIFT key followed by the ON/OFF key to display and enter the T cold temperature in Kelvin. The power-up, PRESET, and total reset default value is 296.5 K.

4. Enter the T cold value for the noise source to be used.

5. Connect the hot noise source to the DUT.

6. Tune the 2075 to the desired frequency.

7. Select Special Function 6.1 (Manual NF measurement).

8. Press the SHIFT key followed by the CALIB key to perform a single-frequency calibration. An automatic FREQ-CAL will be completed and then the GAIN display window will show CAL 0.

9. Press the ON/OFF key to start the hot cycle (green lamp on). The GAIN display window will show CAL1, CAL2, and CAL3.

10 Disconnect the hot noise source and connect the cold noise source.

11. Press the ON/OFF key to start the cold cycle (green lamp off). Observe that the GAIN display window again shows CAL1, CAL2, and CAL3. The NOISE FIGURE display window shows the calibrated noise figure. Upon completion of the calibration, the instrument assumes the F+G mode (F+G red annunciator lamp on).

12. Verify that the NOISE DRIVE power is off (green lamp off) and that the NOISE FIGURE LED display window shows "- -".

13. Disconnect the cold noise source and reconnect the hot noise source.

14. Press the ON/OFF key to start the hot cycle (green lamp on).

15. Disconnect the hot noise source and reconnect the cold noise source.

16. Press the ON/OFF key to start the cold cycle.

17. Observe and record the noise figure reading on the NOISE FIGURE LED display.

18. Reconnect the hot source and press the ON/OFF key to take another reading for the hot cycle.

19. Disconnect the hot source and reconnect the cold source.

20. Press the ON/OFF key to take another reading for the cold cycle.

21. Again observe and record the noise figure reading on the NOISE FIGURE LED display. The difference between the first and second reading will usually be less than 0.1 dB.

GPIB Parameters

There are no GPIB codes associated with this function.

Comments

Since the measurements are taken manually and automatic smoothing is not available, it is usually desirable to make several measurements and average them out. Steps 18 thru 21 of the procedure perform a second measurement and these same steps can be repeated as often as desired to produce a set of manual measurements.

Special Function 12 allows the temperature to be entered as Kelvin, Centigrade, or Fahrenheit.

MANUAL Y-FACTOR MEASUREMENT

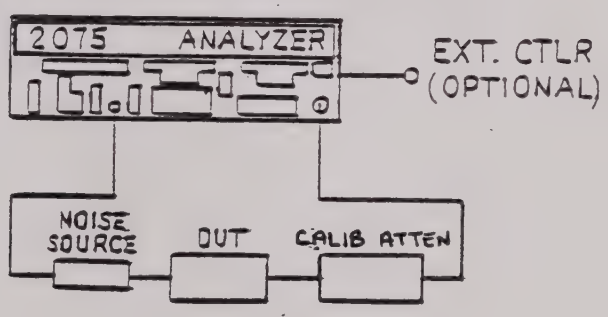
Description

While Special Function 11.1 automatically performs a Y-factor noise figure measurement, the instrument may also be configured to perform a manual Y-factor measurement using an external precision calibrated attenuator.

To make such a measurement, the 2075 is set to the voltmeter mode using Special Function 20.2.

Procedure

In order to make a manual Y-factor measurement, connect the instrument as shown in the following diagram and then follow the specified sequence of steps.



Manual Y-Factor Measurement

1. Select Special Function 20.2 (Voltmeter mode).

2. Set the attenuator to some value (dB) which is greater than the expected Y-factor measurement value. Usually, 15-20 dB should be enough. The gain of the DUT plus the initial attenuator setting should be greater than 25 dB.

3. Turn on the noise source voltage using the ON/OFF key. When the voltage is on, the green NOISE DRIVE lamp will be energized

4. Observe and record the exact voltage readout given on the FREQUENCY MHZ LED display window.

5. Turn off the noise source voltage by pressing the ON/OFF key. When the voltage is off, the green NOISE DRIVE lamp will be extinguished.

6. Reduce the value of the external attenuator until the voltage display on the LED display window is exactly the same as it was in step 4.

7. Compute the difference between the attenuator settings in step 2 and step 6. This difference is the Y-factor in dB.

Example

Using an initial attenuator setting of 15.0 dB, the voltage reading with the noise source on is 2.9805. Turning the noise source off and adjusting the attenuator to give the same 2.9805 voltage reading results in an attenuator setting of 5.35 dB. The computed manual Y-Factor, therefore, is 15.0 dB minus 5.35 dB, or 9.65 dB.

GPIB Parameters

There are no GPIB codes related to this feature.

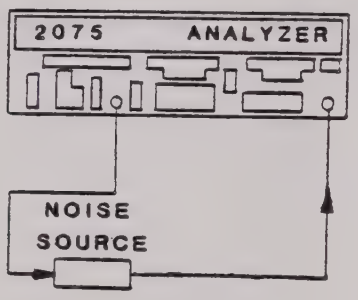
NOISE MEASURE (M)

Description

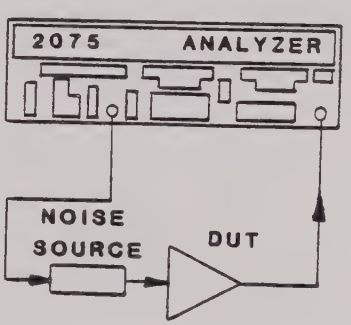
Noise measure (M) is an amplifier parameter which includes both noise figure and gain. This parameter is typically used by transistor manufacturers as a figure of merit.

Procedure

Connect the DUT as follows:



Calibration



Measurement

M can be measured directly by the 2075 as follows:

1. Do a normal second-stage calibration.
2. Select Special Function 11.5.
3. Gain is displayed in the GAIN window.
4. M is displayed in the NOISE FIGURE window.

GPIB Parameters

The GPIB code for Special Function 11.5 is NE.

Comments

The formula for computing M is:

$$M = \frac{(F - 1)}{1 - \frac{1}{G}}$$

where F = Noise Figure of the DUT (ratio).
G = Gain of the DUT (ratio).

NOISE SOURCE POWER AND LAMP

Description

The front panel NOISE DRIVE output supplies the +28 Vdc pulses that energize the external noise source. The lamp indicator immediately above the output connector may be programmed to turn on and off in sync with the voltage pulses, giving a visual verification of the pulse rate. In this mode, the lamp is energized when the noise source is energized. Alternatively, the lamp may be programmed to remain off at all times. This is also the default mode.

Procedure

The lamp is programmed as follows:

Special Function	Lamp Activity
21.0	Remains Off.
21.1	Synchronized with noise source power.

Example

To set the lamp to synchronous mode:

SPEC FUNCT/21.1/ENTER

GPIB Parameters

There is no GPIB control of this activity.

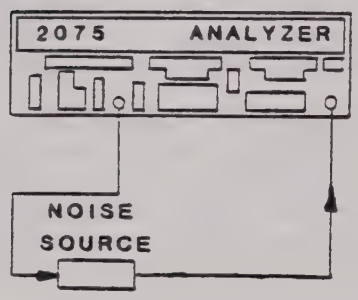
OPERATING NOISE TEMPERATURE (T op) MEASUREMENT

Description

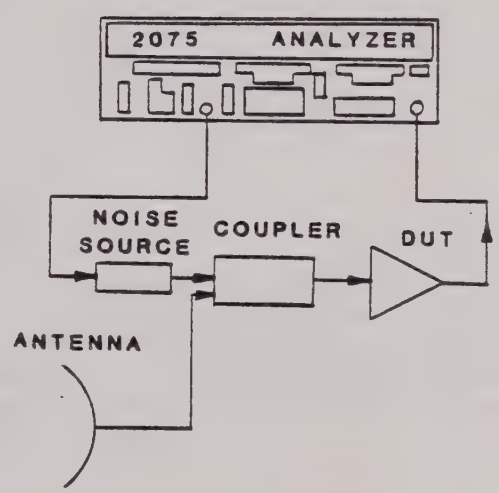
Operating noise temperature is a measurement of the effective noise temperature of a device-under-test (DUT) in a receiver system which includes antenna noise.

Procedure

The setup is as follows:



Calibration



Measurement

It is necessary to program the coupler attenuation factor and the temperature of the attenuator into the 2075 using the loss compensation special functions 18.1 (loss) and 18.2 (temperature). If no loss follows the DUT, then the special function 18.3 loss value must be equal to zero.

If there is a loss following the DUT which is not part of the second stage, then the actual value must be entered using special function 18.3 — see subsection "Loss Compensation."

The measured value of T op will be displayed in the NOISE FIGURE window when Special Function 11.2 is entered. At this time, the T op annunciator will be turned on.

If it is desired to make a cascade T op measurement, first select NF measurement (depress N key) and then select Special Function 11.2.

If it is desired to make a first stage T op measurement only, proceed as follows:

1. Do a normal calibration.

2. Select F+G mode (press F+G key).

3. Enter Special Function 11.2.

Example

Assume the following values:

Room temperature: 296.5 Kelvin
Coupling factor: 10 dB
Frequency of measurement: 1800 MHz
Frequency range of antenna coupler: 1 thru 4.2 GHz

The equipment is connected as shown and the values for room temperature and coupling factor are entered into the 2075 using Special Functions 18.2 and 18.1. To measure the Operating Noise Temperature, enter Special Function 11.2. The result appears in the NOISE FIGURE window and is observed to be 1878 Kelvin. Note that the T (op) Kelvin annunciator in the window is on.

GPIB Parameters

The GPIB code for Special Function 18.1 is L1.
The GPIB code for Special Function 18.2 is L2.
The GPIB code for Special Function 18.3 is L3.
The GPIB code for Special Function 11.2 is OP.

Comments

It is not necessary to select Special Function 17.1 (use loss compensation) in order to use this feature. Special Function 11.2 automatically activates loss compensation.

OSCILLOSCOPES AND RECORDERS TO DISPLAY DATA

Description

The 2075 measurement data can be displayed on an oscilloscope, an X-Y recorder, or a strip chart recorder. The setup procedures for all three devices are similar and only one device may be used at a time. Only NF and Gain can be displayed on the oscilloscope and the units are always in dB.

Procedure

Special Function 7 and front panel keys LOWER LIMIT/UPPER LIMIT are used to select the parameters for recording on oscilloscopes and recorders. The following table shows the various functions of Special Function 7.

Description	SF Code	GPIB Code
Normal Scope Display (NF and Gain vs Freq)	7.0	NP
Display Test Pattern #1 On Scope	7.1	P1
Display Test Pattern #2 On Scope	7.2	P2
Display NF (only) vs Frequency On Scope	7.3	NQ
Display Gain (only) vs Frequency On Scope	7.4	AQ
Move Plotter Pen To Lower Left	7.5	LL
Move Plotter Pen To Upper Right	7.6	UR
Plot NF vs Frequency On Plotter	7.7	FQ
Plot Gain vs Frequency On Plotter	7.8	GQ
X O/P For NF, Y O/P For Gain On Strip Chart	7.9	FG

When the 2075 is powered-up or the PRESET (GPIB Clear) key is pressed, the Noise-Gain Analyzer assumes Special Function 7.2. When a sweep is started, however, the Special Function reverts to 7.0.

The LOWER LIMIT and UPPER LIMIT keys are used to set the lower and upper limits for Noise Figure and Gain when using an oscilloscope or plotter. The non-shifted mode is used to set the limits for Noise Figure and the shifted mode is used for setting the Gain limits. The following key sequences show the exact procedures:

Set Noise Figure Lower Limit	LOWER LIMIT/XXX/ENTER
Set Noise Figure Upper Limit	UPPER LIMIT/XXX/ENTER
Set Gain Lower Limit	SHIFT/LOWER LIMIT/XXX/ENTER
Set Gain Upper Limit	SHIFT/UPPER LIMIT/XXX/ENTER

where XXX is the required dB value.

The allowable range for Noise Figure is 0.00 thru 30.00 dB and the allowable range for Gain is -20.00 dB thru 65.00 dB.

Examples

This example shows the procedure for setting up the 2075 to output a swept Corrected NF and Gain measurement to an oscilloscope and to plot independently the NF and Gain figures. Assume that a DUT has a noise figure range of 0.8 thru 6 dB and gain range of 0 thru 30 dB. Also assume that to present this NF and gain response curve, the limits of the NF will be set to 0 thru 8 dB and the limits for gain will be set to 0 thru 40 dB. To output the data to an oscilloscope proceed as follows:

1. Connect the X-AXIS, Y-AXIS, and Z-AXIS rear panel outputs of the 2075 to the A, B, and Z (horizontal, vertical, and Z) inputs of the oscilloscope. Use DC coupling for the oscilloscope inputs. (The oscilloscope should use positive voltage for blanking in the Z input).

2. Use Special Function 7.2 (GPIB P2) to display test pattern #2 on the oscilloscope and adjust the scope input sensitivity controls so that the test pattern just touches the screen edges on all four sides. Verify that the pattern's diagonal lines cross near the center of the screen. The following figure is a typical oscilloscope display:

3. Enter the noise figure lower limit by pressing the LOWER LIMIT key and entering the required value in dB. When the key is pressed, the right side LED display shows the current programmed value. For the example, the key sequence is:

   LOWER LIMIT/0/ENTER

4. In a similar way, enter the noise figure upper limit by pressing the UPPER LIMIT and entering the required value in dB. For the example, the key sequence is:

   UPPER LIMIT/6/ENTER

5. Enter the gain lower limit by using the SHIFTed LOWER LIMIT key and entering the required value in dB. When the keys are pressed, the center LED display shows the current programmed value. For the example, the key sequence is:

   SHIFT/LOWER LIMIT/0/ENTER

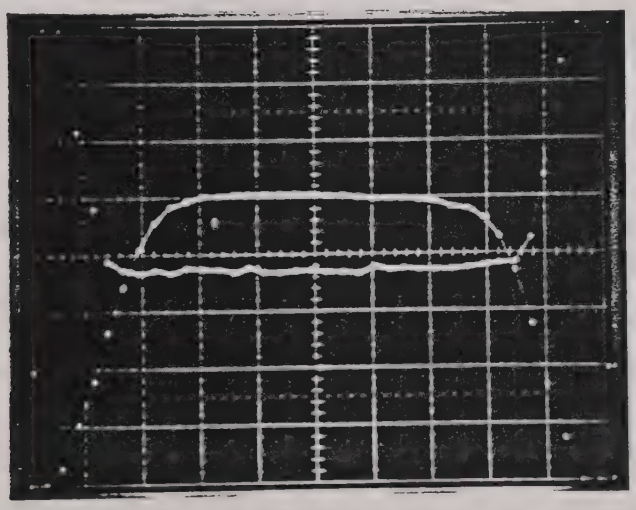
6. In a similar way, enter the gain upper limit by using the SHIFTed UPPER LIMIT key and entering the required value in dB. For the example, the key sequence is:

   SHIFT/UPPER LIMIT/40/ENTER

7. Display the noise figure and gain traces by pressing the SWEEP key.

8. Display the corrected swept measurement by pressing the F+G key

   The following figure is a typical oscilloscope display:



The horizontal line adjacent to the gain trace is the zero base reference line for gain. The horizontal line at the base of the display is the zero base reference line for noise figure.

Observe that as the noise figure measurement is swept through the selected frequency range, the oscilloscope will emphasize the

current frequency by making the corresponding CRT dot of greater intensity. This allows the observer to keep track of the current measurement frequency both on the frequency LED readout and the CRT trace. This feature is particularly useful when tracking the frequencies at which the response curve exhibits unusual characteristics.

The maximum number of "dots" corresponds to the maximum number of frequency increment steps and this is 512.

Note that the brightness of the gain trace can be changed relative to the noise figure trace by adjusting the INTENSITY control on the rear panel of the 2075.

9. To interrupt the sweep, press the SWEEP key again.

10. To perform a single sweep, press the SHIFT/SWEEP keys in sequence.

To output the data to an X-Y Recorder, proceed as follows:

1. Connect the 2075 X-AXIS, Y-AXIS, and Z-AXIS outputs to the X, Y, and pen lift inputs of the X-Y recorder (DC mode on inputs). Be sure that the pen-lift input of the plotter is TTL compatible.

2. Adjust the lower left point on the recorder with Special Function 7.5 (GPIB Code LL) and set the X and Y zero-set controls on the recording device.

3. Adjust the upper right point on the recorder with Special Function 7.6 (GPIB Code UR) and set the X and Y vernier controls on the recording device.

4. Recheck steps 2 and 3 and adjust if necessary.

5. Use Special Function 7.7 (GPIB FQ) to plot a single sweep of the noise figure.

6. Use Special Function 7.8 (GPIB GQ) to plot a single sweep of the gain figure.

   Note that Auto Sweep is not applicable for the plotter.

To output the data to a strip chart recorder, proceed as follows:

1. Connect the 2075 X-AXIS and Y-AXIS outputs to the two channels of the strip chart recorder.

2. Check the lower and upper limits on the recording device and adjust if necessary.

3. Use Special Function 7.9 (GPIB FG) to plot noise figure (X-Axis) and gain (Y-Axis) against time.

POWER MEASUREMENTS

Description

Special Functions 11.3 and 11.4 allow the measurement of noise power density (dB) relative to -174 dBm/Hz. This level is the thermal noise at 290 Kelvin in a 1 Hz bandwidth. Two types of measurement can be made: uncalibrated (approximate) and calibrated. These special functions can be used just to verify that the measurement system is operating correctly or to make absolute power density measurements. Pressing either the F or F+G key will cause an exit from this function.

Procedure

Special Function 11.3 is used to make power measurements with the noise source off.

Special Function 11.4 is used to make power measurements with the noise source turned on.

Uncalibrated measurements assume a nominal noise figure value of 6 dB for the second stage. Calibrated measurements require that a second stage calibration be completed prior to using special functions 11.3 or 11.4. Uncalibrated measurements may be made with Special Functions 11.3 or 11.4 but are not accurate and not recommended.

Example

To make an uncalibrated power measurement with the noise source turned on, proceed as follows:

SPEC FUNCT/11.4/ENTER

GPIB Parameters

The GPIB Code related to Special Function 11.3 is PM. The GPIB Code related to Special Function 11.4 is PN.

Comments

The units shown on the NOISE FIGURE display are dB with reference to 290 Kelvin (-174 dMm/Hz). The equation is as follows:

$$\text{Power (dB)} = \frac{10 \log T \text{ unknown}}{t_0}$$

where T unknown = temperature which is proportional to the unknown power density, and t_0 = 290K reference temperature.

POWER-ON ACTIVITIES

Description

When the 2075 is first turned on, it automatically performs a series of internal checks. Initially, all of the front panel lamps and LED display digits are turned on to verify their operation. Next, the front panel displays "SELF TEST" while a series of six internal tests are performed. These tests briefly check the presence of all the peripheral boards including the Math Processor, Scope/Plotter interface, Analog-to-Digital, RAMS, ROMS, and GPIB. On completion of these tests, the instrument performs a frequency calibration while displaying "FCAL" on the front panel. When the frequency calibration is completed, the 2075 restores the same operating parameters conditions it had before the power was turned off. The only exceptions are:

- The measurement mode is always Uncorrected Noise Figure.
- Calibration data is lost when power is turned off.
- The 2075 is always in Local mode when powered on.
- The sweep is always off.
- The SRQ feature is disabled.

For further information, refer to "Preset, Power-Up Conditions And Total System Reset."

PRESET, POWER-UP CONDITIONS AND TOTAL SYSTEM RESET

Description

Preset

At any time, the PRESET key may be pressed to restore certain of the instrument's parameters to known "nominal" conditions. Parameters not affected by this action will remain unchanged. This action might typically be taken when it is desirable to rapidly change the instrument's operating conditions back to a known state.

Power-Up

When the 2075 is powered up, the unit mostly uses the parameter values that were previously in operation before the unit was powered down.

The following table, Table 5-3, summarizes the effective parameter values for the Preset, Reset, and Power-Up conditions. The last column of the table indicates whether or not the parameter can be stored and recalled using continuous memory.

Total System Reset

This function should be used the first time the 2075 is received from the factory or when it is used after a long period of inactivity. Its function is a total system cleanup. It first erases all the battery backed-up data and then restores several parameters to their nominal condition. Therefore, this feature can also be used as a security measure after confidential measurements have been made. All ENR tables, measurement parameters, and IF calibrations will be lost.

Table 5-3. Preset, Power-Up Conditions, And Total System Reset

Parameter	Preset or GPIB Clear	Total Reset SF 0.1	Power Up Condition	Store/ Recall
Start Frequency	10 MHz	All the	Uses the	Y
Stop Frequency	1800 MHz	same as	value that	Y
Step Size	20 MHz	for the	was selected	Y
Fixed Frequency	30 MHz	Preset	prior to	Y
Manual Step Size	20 MHz	column	power off	Y
Smoothing	1 unit	"	"	Y
IF Frequency	30 MHz	"	"	Y
LO Frequency	10 GHz	"	"	Y
Second LO Frequency	10 GHz	"	"	Y
LO Amplitude	0 dB	"	"	Y
NF Minimum Limit	0 dB	"	"	Y
NF Maximum Limit	30 dB	"	"	Y
Gain Minimum Limit	-20 dB	"	"	Y
Gain Maximum Limit	80 dB	"	"	Y
T cold	296 K	"	296 K	Y
T hot	9893 K	"	9893 K	Y
Default ENR Value	15.5 dB	15.5 dB	15.5 dB	SF 5.x
ENR Table 1	|Uses the|	cleared	|Uses the|	is store/
ENR Table 2	|previous|	cleared	|previous|	recallable
ENR Table 3	|entries |	cleared	|entries |	
ENR (ROM) if used	ROM value	ROM value	ROM value	
Calibration Tables	Uses the previous data	cleared	cleared	N

The effective values of the Special Functions are given in the subsection "Special Functions."

SERVICE AID, DETECTOR VOLTAGES AND ATTENUATOR SETTINGS

Description

As a troubleshooting service aid, the 2075 allows display of the detector noise source on (E on) and noise source off (E off) voltages as well as RF and IF attenuator settings. These figures are available through Special Function 20.1 and 20.2. The measured values are displayed on the front panel's three LED panels -- FREQUENCY MHz (display 1), GAIN (display 2), and NOISE FIGURE (display 3).

Procedure

Special Function 20.1 causes the following information to be displayed:

Display 1	Display 2	Display 3
E off	RF attenuator	IF attenuator

Special Function 20.2 causes the following information to be displayed:

E on	RF attenuator	IF attenuator

Special Function 20.0 causes the instrument to revert back to normal measurement mode. (Simply pressing the F key has the same effect).

Example

To display E off, RF attenuator, and IF attenuator proceed as follows:

SPEC FUNCT/20.1/ENTER

Note that 20.2 enables the automatic attenuation feature while 20.1 uses whatever attenuation is in effect.

SMOOTHING FACTOR

Description

In order to reduce "jitter" in the displayed noise and gain figures, the 2075 uses a smoothing (averaging) function with a variable smoothing factor. The greater the degree of smoothing selected, the greater the number of readings that are averaged prior to displaying the measured results and hence the less fluctuations. The smoothing factor is programmable from the front panel and via the GPIB, and can be varied between 1 (minimum smoothing) and 512 (maximum smoothing).

The Smoothing Factor is indicated by the front panel SMOOTHING indicator which is a series of ten LED light bars. The left most position represents two to the power of zero, or a smoothing factor of one. The next position represents two to the power of one, or a smoothing factor of two. Similarly, the remaining light bars represent two to the power of three, four, five, six, seven, eight and nine. The number of LED light bars energized is referred to as the Smoothing Number. The available smoothing factor range, therefore, extends from one (left most LED on) thru 512 (all LEDs on) and the formula for the smoothing factor is given by:

$$\text{Smoothing Factor} = 2^{(SN - 1)}$$

where SN = Smoothing Number

There are two methods of applying the smoothing: arithmetically and exponentially. During fixed frequency operations, the smoothing factor is applied exponentially. The formula is as follows:

$$\text{Displayed Value} = \frac{P(S-1) + D}{S}$$

where P is the Previous Data Value
D is the Present Data Value and
S is the Smoothing Factor selected.

As an example, assume a Smoothing Number of six, representing a smoothing factor of 32. The above formula becomes:

$$\text{Displayed Value} = \frac{P(32-1) + D}{32} \quad \text{or,} \quad \frac{31P + D}{32}$$

The smoothing algorithm is designed to give progressively greater weight to prior measurements as the smoothing factor is increased. The exception to this statement is the first measurement in a new or start-up configuration. In this case, the measured data is displayed without smoothing because no previous data is available.

If the smoothing factor is set at one, then there is no smoothing and the displayed value is equal to the present data value for each measurement cycle.

During sweep frequency operations, the smoothing factor is applied arithmetically. In this method, the number of readings taken is equal to the smoothing factor and the readings are averaged out to produce the displayed value. The formula is as follows:

$$\text{Displayed Value} = \frac{\text{S (measurements)}}{\text{S}}$$

In arithmetic smoothing, the display is updated every time that **S** readings have been taken.

Procedure

The smoothing factor is altered with the two SMOOTHING keys located immediately below the SMOOTHING indicator. Depressing the left-arrow key reduces the smoothing factor while the right-arrow key increases the degree of smoothing.

Example

The following table shows the displayed data for a series of measurement cycles in which the measured data jitters normally for five measurement cycles and then shifts to a relatively constant value for the remaining cycles. The displayed data is shown for several different smoothing factors. The effect is further illustrated by a graph of the displayed data versus measurement cycle for each of the smoothing factors.

n	$M_{(n)}$	DISPLAYED DATA					
		1	2	3	4	8	Smoothing Number
		1	2	4	8	128	Smoothing Factor
1	2.52	2.52	2.52	2.52	2.52	2.52	
2	2.48	2.48	2.50	2.51	2.52	2.52	
3	2.56	2.56	2.53	2.52	2.52	2.52	
4	2.53	2.53	2.53	2.52	2.52	2.52	
5	2.49	2.49	2.51	2.52	2.52	2.52	
6	2.45	2.45	2.48	2.50	2.51	2.52	
7	2.44	2.44	2.46	2.48	2.50	2.52	
8	2.45	2.45	2.46	2.48	2.49	2.52	n = measurement cycl
9	2.45	2.45	2.45	2.47	2.49	2.52	$M_{(n)}$ = measured data
10	2.44	2.44	2.45	2.46	2.48	2.52	

As can be seen from the data, a higher smoothing factor reduces the jitter, but also increases the time required for the display to a react to a change.

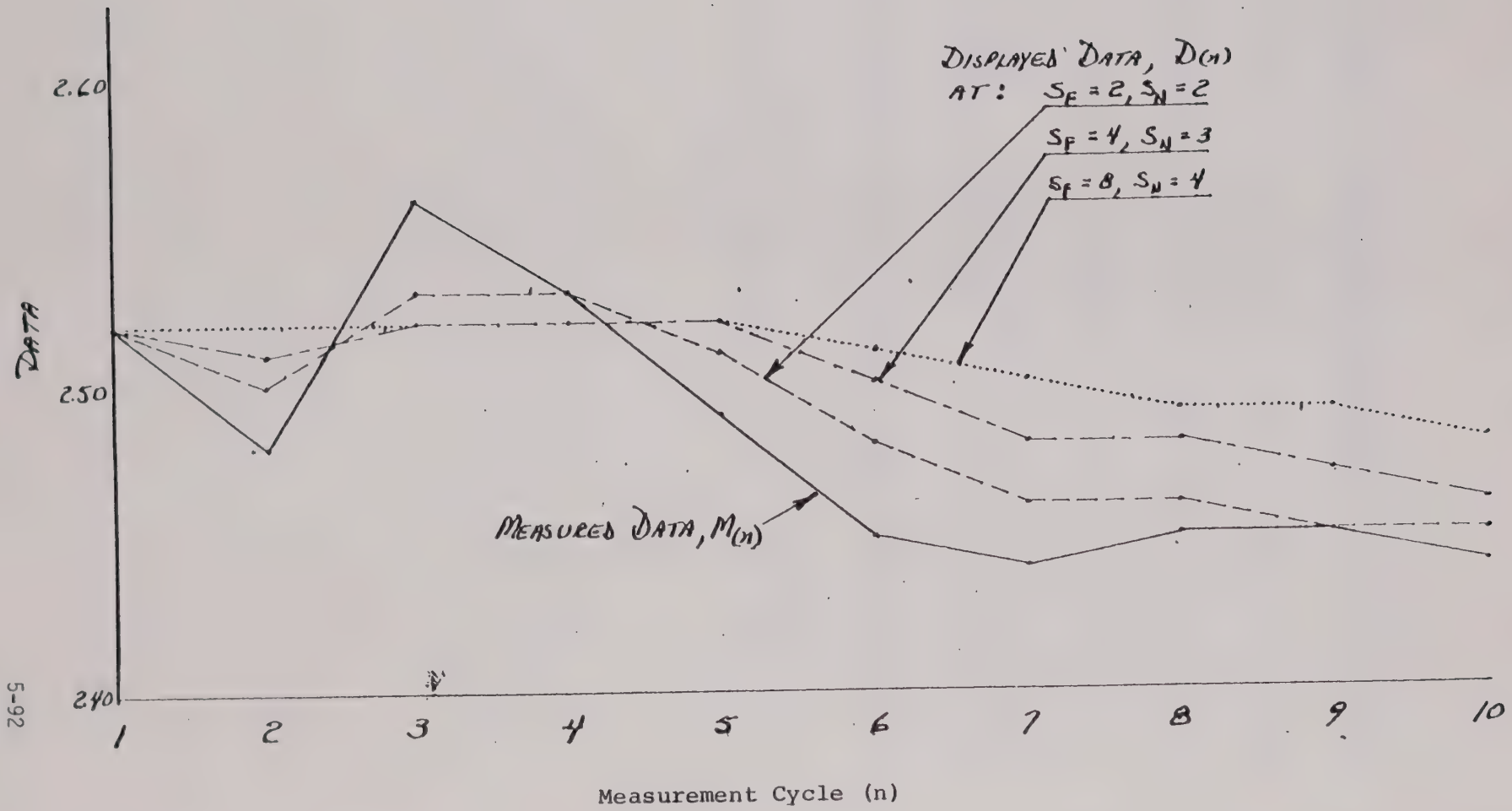
GPIB Parameters

The following GPIB codes control the smoothing factor:

Smoothing Factor	GPIB Code
1	S0
2	S1
4	S2
8	S3
16	S4
32	S5
64	S6
128	S7
256	S8
512	S9

Comments

The 2075 offers a wide range of smoothing and the actual degree of smoothing selected will depend on the measurement situation. Generally, light smoothing and fast response are good for "quick look"


DISPLAYED DATA, D(n)
AT: $S_F = 2, S_N = 2$
$S_F = 4, S_N = 3$
$S_F = 8, S_N = 4$
MEASURED DATA, M(n)
2.60
2.50
2.40
DATA
1
2
3
4
5
6
7
8
9
10
Measurement Cycle (n)

measurements, while heavy smoothing is suitable for the observation of long term trends. Intermediate smoothing values are appropriate for most normal measurement situations. Some additional considerations are:

- o Heavy smoothing (slower response) can be tolerated for a single frequency precision measurement.
- o Heavy smoothing is desirable for a single frequency noise stability check versus time.
- o Heavy smoothing is necessary for high resolution measurements as the noise figure or temperature increases.
- o Light smoothing (faster response) is desirable for swept measurements to increase measurement speed (reduce the time required for a complete sweep) especially when the results are displayed on a low resolution output device such as an oscilloscope or X-Y recorder.
- o Light smoothing is desirable when a DUT is being adjusted for optimum noise performance so that the effect of the adjustments can be observed virtually instantaneously.

The smoothing factor cannot be changed during calibration or while swept measurements are in progress.

SPECIAL FUNCTIONS

Description

Special Functions extend the range of the instrument's available features beyond those limited to the front panel's normal dedicated function keys. They are accessed through Special Function Codes which are entered through the front panel numeric keypad. The codes consist of a prefix, a decimal point, and a suffix.

Procedure

Special Function Codes are accessed as follows:

SPEC FUNCT/XX.X/ENTER

where XX.X is the code.

The following table, Table 5-4, lists all of the available codes and their function.

Example

To enter Special Function Code 16.1:

SPEC FUNCT/16.1/ENTER

Comments

When the SPEC FUNCT key is pressed, "SP Fn" is displayed on the front panel in the FREQUENCY window. By pressing the up-arrow key, the 2075 will index through the special function table (ascending sequence) and the middle window (GAIN) will display each of the available special functions and their current settings. Similarly, pressing the down-arrow key will display the available special functions in descending sequence.

Table 5-4. Summary Of Special Function Codes.

Function Type	SF Code	Power Up	S/R	GPIB Code	Function Description
Total Reset	0.0	0.0	N	N/A	Normal measurement
	0.1				Erase BBU RAM data
Select DUT Configurtn	1.1	PREV	Y	D1	DUT Configuration 1 (Standard default)
	1.2			D2	DUT Configuration 2 (fixed IF; varbl LO)
	1.3			D3	DUT Configuration 3 (varbl IF; fixed LO)
	1.4			D4	DUT Configuration 4 (fixed IF; varbl LO
	1.5			D5	DUT Configuration 5 (varbl IF; fixed LO
	1.6			D6	DUT Configuration 6 (2 LO's;fixed & varbl)
Sideband Selection	2.0	PREV	Y	A0	Double Sideband (no offset)
	2.1			A1	Lower Single Sideband
	2.2			A2	Upper Single Sideband
Settle Time	3.0	PREV	N	N/A	Normal Measurement
	3.1			ST	Display/Enter Ext LO settling time
Bandwidth Compensatn	4.0	4.0		N0	Disable bandwidth compensation
	4.1			N1	Display/Enter DUT bandwidth & go to 4.0
	4.2			N2	Display/Enter 2nd stage BW & go to 4.0
	4.3			N3	Enable bandwidth compensation
ENR Table Selection	5.0	PREV	Y	B0	Use nominal value of ENR
	5.1			B1	Use ENR Table 1 (User must enter)
	5.2			B2	Use ENR Table 2 (User must enter)
	5.3			B3	Use ENR Table 3 (User must enter)
	5.4			B4	Use ROM ENR Table. Special ROM required
Measurement Mode	6.0	6.0	N	N/A	Normal measurement
	6.1			N/A	Manual Noise Figure measurement
X/Y Output Configurtns	7.0	7.2	N	NP	Display NF and Gain vs Freq on scope
	7.1			P1	Display test pattern #1 on scope
	7.2			P2	Display test pattern #2 on scope
	7.3			NQ	Display NF (only) vs freq on scope
	7.4			AQ	Display gain (only) vs freq on scope
	7.5			LL	Move plotter pen to lower left
	7.6			UR	Move plotter pen to upper right
	7.7			FQ	Plot NF vs frequency on plotter *
	7.8			GQ	Plot gain vs frequency on plotter *
	7.9			FG	Plot on strip chart,X-out=NF/Y-out=G
Display Revision #	8.0		N	N/A	Normal Measurement
	8.1			N/A	Display software update number
Frequency Resolution	9.0		N	RF	Normal 1 MHz frequency resolution
	9.1			RN	100 KHz frequency resolution

S/R = Store/Recall Capability PREV = Previous value used before power down
* = Activated by single sweep

Table 5-4. Summary Of Special Function Codes (contd.)

Function Type	SF Code	Power Up	S/R	GPIB Code	Function Description
Enter GIGA Sweeper Frequency	10.0		N	N/A	Normal measurement
	10.1			N/A	Display/Enter GIGA Swpr min frequency
	10.2			N/A	Display/Enter GIGA Swpr max frequency
Special Measurement Selection	11.0	PREV	N	NF	Cascade NF measurement (normal mode)
	11.1			YF	Y-Factor measurement
	11.2			OP	Operating Noise Temperature(K) msmnt
	11.3			PM	Power measurement (NS off)
	11.4			PN	Power measurement (NS on)
	11.5			NE	"Noise measure" measurement
Temperature Units Selection	12.0	PREV	N	SK	Temperature units in Kelvin
	12.1			SC	Temperature units in Centigrade
	12.2			SF	Temperature units in Farenheight
Display ENR In Use	13.0			CO	Normal measurement
	13.1			CE	Display ENR in use
Triggered Measurement	14.0	14.0	N	T0	Normal continuous measurement
	14.1			T1	Hold measurement cycle
	14.2			T2	Execute one measurement cycle and hold
Frequency Calibration Selection	15.0	15.0	N	AF	Normal automatic frequency calibration
	15.1			FC	Do a freq calibrtn and return to 15.0
	15.2			DF	Disable auto freq calibration function
Second Stage Calibration Configurtn	16.1	16.1	N	C1	Use calibration setting #1(0,15,30 dB)
	16.2			C2	Use calibration setting #2(15,30,40 dB)
	16.3			C3	Use calibration setting #3(30,40,55 dB)
Loss Compensatn Select	17.0	17.0	N	NS	No loss compensation
	17.1			LC	Use loss compensation (use with SF 18)
Display and Enter Loss Data	18.0	18.0	N	L0	Normal measurement
	18.1			L1	Enter loss before the DUT (dB)
	18.2			L2	Enter temperature of DUT before loss
	18.3			L3	Enter loss after the DUT (dB)
IF Attenuat Calibration	19.0	19.0	N	N/A	Normal measurement
	19.1			IC	Do IF atten calibrtn and go to 19.0
Voltage/Att Display Mode	20.0	20.0	N	V0	Normal measurement
	20.1			V1	Display E-off voltage in window A; RF attenuator setting in window B; IF attenuator setting in window C
	20.2			V2	Display E-on voltage in window A; RF attenuator setting in window B; IF attenuator setting in window C (with auto attenuation)

Table 5-4. Summary Of Special Function Codes (contd.)

Function Type	SF Code	Power Up	S/R	GPIB Code	Function Description
Noise Sourc Annunciator Selection	21.0	21.0	N	LD	Noise source lamp is off
	21.1			LE	Lamp is on when NS power is on and off when NS power is off
Time Delay In Use	22.0		N	GF	Normal measurement (no time delay)
	22.1			GS	Time delay to ignite gas NS (1mS)
Display Blanking	23.0	23.0	N	DE	Normal measurement
	23.1			DD	Blank all displays during measurement (for GPIB operations only)
Interpolatn Selection	24.0	PREV	N	MC	Prohibits NF/G measurements at non-calibrated points
	24.1			MN	Uses interpolation for measurements at non-calibrated points (low accuracy)
Special Functions 30 thru 39 are service functions for use by service personnel only	30.0	30.0	N	N/A	Return to NF measurement
	30.1			N/A	Hysterisis calibration test
	30.2			N/A	Zero frequency adjust
	30.3			N/A	Low frequency adjust
	30.4			N/A	High frequency adjust
	30.5			N/A	Digital latch test
	31.0	31.0	N	N/A	Return to NF measurement
	31.1			N/A	Display test
	31.2			N/A	Keyboard test
	32.0	32.0	N	N/A	Return to NF measurement
	32.1			N/A	Memory board RAM test
	32.2			N/A	CPU board RAM test
	32.3			N/A	Scope/Plotter RAM test
	33.0	33.0	N	N/A	Return to NF measurement
	33.1			N/A	ROM-1 checksum
	33.2			N/A	ROM-2 checksum
	33.3			N/A	ROM-3 checksum
	33.4			N/A	ROM-4 checksum
	33.5			N/A	ROM-5 checksum
	33.6			N/A	ROM-6 checksum
	33.7			N/A	ROM-7 checksum
	33.8			N/A	ROM-8 checksum
	33.9			N/A	ROM-9 checksum
	34.0	34.0	N	N/A	Return to normal measurement
	34.1			N/A	DMAC chip test
	34.2			N/A	GPIB chip test
	34.3			N/A	Math chip test

Table 5-4. Summary Of Special Function Codes (contd.)

Function Type	SF Code	Power Up	S/R	GPIB Code	Function Description
	35.0		N	N/A	Normal measurement
	35.1			N/A	RF gain peak search
	36.0				Not Used
	37.0	37.0	N	N/A	Automatic RF attenuator
	37.1			N/A	Fixed RF attenuator at 0 dB
	37.2			N/A	Fixed RF attenuator at 15 dB
	37.3			N/A	Fixed RF attenuator at 30 dB
	37.4			N/A	Fixed RF attenuator at 40 dB
	37.5			N/A	Fixed RF attenuator at 55 dB
	38.0	38.0	N	N/A	Auto IF atten (mutually exclsv with 39.x)
	38.1			N/A	Fixed IF attenuator at 0 dB
	38.2			N/A	Fixed IF attenuator at 5 dB
	38.3			N/A	Fixed IF attenuator at 10 dB
	38.4			N/A	Fixed IF attenuator at 15 dB
	38.5			N/A	Fixed IF attenuator at 20 dB
	39.0	39.0	N	N/A	Auto IF atten (mutually exclsv with 38.x)
	39.1			N/A	Fixed IF attenuator at 25 dB
	39.2			N/A	Fixed IF attenuator at 30 dB
	39.3			N/A	Fixed IF attenuator at 35 dB
	39.4			N/A	Fixed IF attenuator at 40 dB
	39.5			N/A	Fixed IF attenuator at 45 dB
SRQ Configurtn (for GPIB)	40.0	40.0	Y	N/A	Normal addressable talker/listener mode
	40.1			N/A	Talk-only mode
	40.2			N/A	Controller mode (addressing external LO)
	41.0				Not used
	41.1				
	42.0	42.0	N	NI	All SRQ's disabled
	42.1			RA	SRQ on "data ready"
	43.0	43.0	N	NI	All SRQ's disabled
	43.1			RC	SRQ on "calibration complete"
	44.0				Not used
	44.1				
	45.0	45.0	N	NI	All SRQ's disabled
	45.1			RT	SRQ on "ready to tune"
	46.0	46.0	N	NI	All SRQ's disabled
	46.1			RI	SRQ on instrument error

Table 5-4. Summary Of Special Function Codes (contd.)

Function Type	SF Code	Power Up	S/R	GPIB Code	Function Description
Externl LO Control Program Selection	47.0	PREV	Y	N/A	Control program for HP 8672 LO
	47.1			N/A	Control pgm for Wiltron 6600 Sweeper
	47.2			N/A	Control program for GIGA Sweeper
	47.3			N/A	Control program for HP 8350A
	47.4			N/A	Control program defined by 48.1
Externl LO Control Program Parameters	48.0	PREV	N	N/A	Normal measurement
	48.1			N/A	Define control function to be selected by Special Function 47.4
GPIB Output Format Selection	49.0	PREV	N	F0	Output window C data only to GPIB
	49.1			F1	Output window B data only to GPIB
	49.2			F2	Output window A data only to GPIB
	49.3			F3	Output window A and B data to GPIB
	49.4			F4	Output window A and C data to GPIB
	49.5			F5	Output window B and C data to GPIB
	49.6			F6	Output window A, B, and C data to GPIB

On a front panel PRESET (GPIB Clear) condition, the special functions in this table will assume the same status as given in the "Power Up" column.

On a Total Reset (Special Function 0.1), all of the special functions in this table will assume the zero condition. For example, SF 2.x will revert to 2.0; SF 4.x will revert to 4.0, etc.). The only exceptions to this are:

Special Function 1.x will revert to 1.1

Special Function 7.x will revert to 7.2

Special Function 16.x will revert to 16.1

Special Function 47.x will revert to 47.1

SWEEP FREQUENCY

Description

In Sweep mode, the 2075 will sweep the measurement frequency from a start frequency to a stop frequency in discrete steps. These frequencies are defined by the START FREQ, STOP FREQ, and STEP SIZE keys.

In DUT Configuration 1, the allowable sweep range is 10 MHz thru 1800 MHz with a minimum step size of 0.1 MHz.

In DUT Configurations 2 thru 7, the allowable sweep range is 1 MHz thru 65 GHz. These limitations are based on the ranges of the external local oscillator and noise source.

There are two sweep modes available; Auto Sweep and Single Sweep. These are accessed by the SWEEP and SHIFT/SWEEP keys respectively. Auto Sweep causes the sweeping cycle to repeat continuously until interrupted, while Single Sweep executes a single sweep only. At the completion of a single sweep, the 2075 remains tuned to the stop frequency.

The minimum step size is 0.1 MHz. For one sweep, the maximum allowable number of frequency points is given by:

$$\frac{\text{Stop Frequency} - \text{Start Frequency}}{\text{Step Size}} + 1$$

When an oscilloscope is used to display the sweep information, the maximum number of points is limited to 256.

Procedure

1. Enter the Start Frequency as follows:

   START FREQ/XX/ENTER

2. Enter the Stop Frequency as follows:

   STOP FREQ/XX/ENTER

3. Enter the Step Size as follows:

   STEP SIZE/XX/ENTER

4. Select either Continuous or Single Sweep.

Note that XX represents a frequency value in MHz.

To cancel a continuous sweep or a single sweep, press the SWEEP key.

Example

To initiate a continuous sweep, from 400 MHz thru 1800 MHz, using a step size of 10 MHz, proceed as follows:

START FREQ/400/ENTER
STOP FREQ/1800/ENTER
STEP SIZE/10/ENTER
SWEEP

GPIB Parameters

The GPIB codes for sweep related functions are as follows:

Function	GPIB Code
Auto Sweep	SR
Single Sweep	SG
Start Frequency	FA
Stop Frequency	FB
Step Size	SS

Comments

If the final increment (STEP SIZE) of a sweep operation would cause the frequency to exceed the programmed stop frequency (STOP FREQ), then the 2075 only tunes a partial increment and stops at the stop frequency. It should be noted, however, that the partial increment will appear as an equal increment on an oscilloscope display.

If a sweep operation is attempted where the stop frequency is less than the start frequency, an error message appears and the sweep is aborted.

The SWEEP key has a toggle action and if pressed a second time will cancel the current sweep activity.

While a sweep operation is in progress, the only active key is the SWEEP key.

The START FREQ, STOP FREQ, and STEP SIZE keys also establish the calibration (FCAL) parameters — see Section 5.7 Calibrate. During calibration, the maximum allowable number of frequency calibration points is 100.

T Cold COMPENSATION

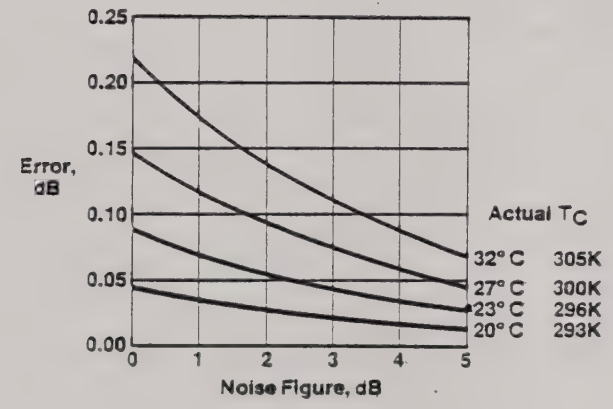
Description

T cold is the OFF temperature of the noise source and is the ambient temperature of the room wherein the measurement is being made.

When the instrument is powered-up, reset, or preset, the value of T Cold is automatically set to 296.5 Kelvin. While this temperature is likely to be close to the actual ambient room temperature, for the highest level of accuracy, it is important to measure and enter the true value of the ambient room temperature (T Cold).

The level of error increases as the actual value of T Cold deviates away from 296.5 and as the value of noise figure is reduced.

The following graph shows the severity of the error as the actual value of T Cold deviates from 290 Kelvin.



Exact equation:

$$F = \frac{10^{ENR/10} - Y(T_C/290 - 1)}{Y - 1}$$

Procedure

To enter the actual true value of T Cold, use the following sequence of keys:

SHIFT/(ON/OFF)/XXX.X/ENTER

where XXX.X is the actual T Cold value. The units of temperature measurement are selected by Special Function 12.

Example

To enter the true value of 298.3 for T Cold, proceed as follows:

SHIFT/ON/OFF/298.3/ENTER

GPIB Parameters

The related GPIB Code is TC.

Comments

In the above graph, the degree of error is derived from the following equations:

The inexact equation is: $f = \dfrac{t_H - 290K}{290K} \Big/ (Y - 1)$

The exact equation is: $f = \dfrac{\left[\dfrac{t_H - 290K}{290K}\right] - Y\left[\dfrac{t_C - 1}{290K}\right]}{Y - 1}$

0.1 MHz FREQUENCY DISPLAY RESOLUTION

Description

Special Function 9 controls the 0.1 MHz display resolution feature of the 2075 Noise-Gain Analyzer. When the 0.1 MHz resolution is in effect, the Frequency MHz display will show one decimal place -- 100.0, for example. If this feature is turned off, the frequency is displayed only in units of MHz.

Since DUT Configuration 1 operates within the basic range of the instrument (10 to 1800 MHz), the 0.1 MHz display resolution feature may be used in this configuration. DUT Configurations 2 thru 6, however, operate at much higher frequencies, thus making 0.1 MHz frequency display resolution impractical.

When 0.1 MHz display resolution is not in effect, a frequency of 100.9 MHz, for example, will be displayed as 100 MHz.

Procedure

Special Function 9.0 turns off the 0.1 MHz display resolution.

Special Function 9.1 turns on the 0.1 MHz display resolution.

Example

To turn on the 0.1 MHz resolution feature, proceed as follows:

SPEC FUNCT/9.1/ENTER

GPIB Parameters

The related GPIB Code is RN.

Comments

It is important to note that even if 0.1 MHz display resolution is not in effect, the user may still increment the frequency in 0.1 MHz steps. In this case, the incrementation will take place but the frequency readout will not register the imtermediate steps. As an example, if the frequency is incremented from 100.0 MHz to 101.0 MHz in 0.1 MHz steps, the readout will only show 100 MHz while the frequency changes from 100 MHz thru 100.9 MHz.

Section VI

GPIB OPERATION

6.1 INTRODUCTION

This section covers the procedures related to the operation of the 2075 through the GPIB. Additional GPIB information is given in the "example" segment of the six DUT Configuration subsections in Section 5.6, Detailed Operating Procedures. The instrument can operate remotely in three mutually exclusive modes: Normal Talker/Listener Mode, External LO Control Mode, and Talk Only Mode. The modes are selected using Special function 40. Most of the front panel functions, special functions and remote-only functions are programmable through the GPIB.

6.2 OPERATING MODES

1. Normal Talker/Listener Mode is used when the 2075 is controlled by a GPIB compatible computer or controller. This mode is used for setting up measurement parameters and transferring measured data. It is selected with Special Function 40.0. This mode is also assumed when the 2075 is powered up.

2. Talk Only Mode is used to transfer data to a device that is operating in the Listen Only Mode. Typically this is used to dump measurement data to a GPIB compatible printer. This mode is selected with Special Function 40.1

3. External LO Control Mode is used when the 2075 controls the operation of an external local oscillator without an external controller. This mode is selected with Special Function 40.2.

6.3 GPIB COMPATIBILITY

The 2075 GPIB can interface with any GPIB compatible controller or computer. The GPIB functional capabilities of the 2075 are:

AH1	Complete acceptor handshake
SH1	Complete source handshake
T5	Complete talker
L4	Complete listener except no Listener-Only
SR1	Complete service request
RL1	Complete Local/Remote
PP0	No parallel poll
DC1	Complete Device Clear
DT1	Complete Device Trigger
C1	System Controller
C3	Capable of sending REN
C28	Capable of sending interface message only

For a more detailed explanation of these codes, refer to IEEE Standard 488-1978 and the ANSI Standard MC1.1.

The programming capabilities of the GPIB are described by Tables 6-1, 6-2, and 6-3.

6.4 LOCAL AND REMOTE OPERATION

The 2075 communicates on the GPIB interface in both Local and Remote modes. Following is a discussion of both modes of operation.

6.4.1 Local Operation

When operating in Local, the front panel controls of the 2075 are fully operational. The instrument also responds to the Local Lockout, Clear Lockout/Set Local, and the Abort messages, even though the front panel display may not show such responses.

While in the remote mode, whenever the instrument receives the Local message (GTL) or the Clear Lockout/Set Local message it switches from remote to local mode. If Local Lockout is not in effect, it can also be switched to local by pressing the LOCAL key

6.4.2 Local Lockout

When the LOCAL key is pressed to return the instrument to Local mode, data transmission may be interrupted causing the loss of data. In this case, the instrument would be left in an unknown operating mode. To avoid this situation, it is recommended that local lockout be used. This disables the LOCAL key and permits return-to-local only under program control.

6.4.3 Addressing The 2075

When Special Function 40.0 is in effect, the 2075 can be addressed either to listen or to talk. In either case, the proper device address must be set up before the instrument is addressed. This can be done using the LOCAL key while the instrument is in Local Mode. Legal GPIB addresses are 0 thru 30. To make it easy for the user, the 2075 address is set to eight (8) when it leaves the factory and this value is stored in BBU memory until changed by the user. If a total system reset is executed (Special Function 0.1), the address will also be reset to eight.

6.4.4 Remote Operation

In this mode, all of the instrument's front panel controls (except LOCAL) are disabled and all control comes from the bus as Program Messages.

When the Remote messages are received, the 2075 switches to remote operating mode and the front panel REMOTE annunciator is energized. The controller sends the remote messages to the 2075 in the following sequence:

a. Set the remote enable bus line (REN) true.

b. Send listen address while REN is true.

These two actions combine to place the 2075 in remote listener mode. Thus, the instrument is enabled to go into remote when the REN is set true, but it does not actually switch to remote until addressed to listen the first time.

6.5 GPIB MESSAGES

The 2075 communicates on the GPIB interface bus through GPIB messages. The messages are composed of one or more bytes which are transmitted over the bus in a byte serial, bit parallel manner.

The 2075 handles four categories of GPIB messages: Interface Messages, Program Messages, Measurement Messages, and Status Messages. The description and syntax of each category follows.

6.5.1 Interface Bus Messages

These are device independent messages defined by the IEEE-488-1980 specifications. They are sent to the device by the controller while the ATTN line is true (i.e. when the bus is in command mode). These messages include Device Clear, Trigger, Local, Local Lockout, etc. and are completely defined in Table 6-3. In general, they can be grouped as the Universal Command Group (UCG) and the Addressed Command Group (ACG). The UCG affects all devices on the bus while the ACG affects only those that have been addressed.

6.5.1.1 Clear Message

When the 2075 receives a Clear message, it assumes the conditions specified in Tables 5-3 and 5-4. The 2075 also responds to the Selected Device Clear (SDC) command (ACG) when it is addressed to listen, and the Device Clear (DCL) command (UCG) whether addressed or not. The Clear message clears any Require Service messages and then resets the Service Request Condition.

See Table 5-4 for a complete list of the Special Functions that are turned off or not affected by the Clear Message.

6.5.1.2 Trigger Message

When in remote mode and addressed to listen, the 2075 responds to a Group Execute Trigger (GET) message (UCG) by executing one complete measurement cycle. A Program message, T2, will cause the same response.

6.5.1.3 Remote Message

The 2075 is placed in remote mode by a Remote message which is composed of two steps: first, the remote enable bus control line (REN) is held true, and second, the device listen address is sent by the controller. While the REN line is held true, the 2075 does not actually switch to remote until addressed to listen. When the instrument switches from local to remote, none of the 2075 settings are changed except that all front panel keys (except LOCAL) are disabled and all key functions now come from the controller. The front panel REMOTE annunciator lights when the instrument is actually in remote mode.

6.5.1.4 Local Message

The Local message is the Go To Local (GTL) bus command (UCG). While in the remote mode, the Local message causes the 2075 to return to normal front panel operation. If the 2075 is in local lockout when the Local message is received, front panel control is returned but lockout is not cleared. If the 2075 does not receive the Clear Lockout/Set Local message, it will return to local lockout when next set to remote. The change from remote to local does not change any of the instrument settings. When the instrument switches to local mode, the front panel REMOTE annunciator is extinguished.

If the 2075 is not in local lockout, it is possible that pressing the LOCAL key might interrupt a Data message currently being sent to the instrument. To prevent this action, the front panel keys can be disabled using the Local Lockout message.

6.5.1.5 Local Lockout Message

This message causes the controller to send the Local Lockout (LLO) command (ACG). If set to remote, the 2075 responds to the message by disabling the front panel LOCAL key and all other keys. If, while set to local, the 2075 is enabled to remote and it receives the Local Lockout message, it will switch to remote with local lockout the first time when addressed to listen. If in local lockout, the 2075 can be returned to local by using either the Local or Clear Lockout/Set Local message. It can also be returned to local by turning the POWER switch to OFF and back to ON, or removing the GPIB interface cable.

6.5.1.6 Clear Lockout/Set Local Message

The controller sends this message by setting the Remote Enable (REN) control line false. When this happens, the 2075 immediately returns to local mode, clears the Local Lockout, and returns to normal front panel control. The transition from remote to local does not change any of the instrument settings except it causes the REMOTE annunciator to be extinguished.

6.5.1.7 Abort Message

The controller sends the abort message by setting the Interface Clear (IFC) bus control line true momentarily (UCG). On receiving an abort message, the 2075 (and all other devices on the bus) become unaddressed and cease talking or listening activities.

6.5.2 Program Messages

These are messages sent from the controller to the 2075 when the ATT line is false (i.e. when the bus is in data mode). These messages are typically parameters used to set up the 2075 in preparation for a measurement, and are device dependent function commands. The 2075 must be addressed to listen in order to receive program messages.

These messages are used when writing control programs to make the 2075 perform measurements automatically and remotely. The messages are sent to the 2075 from a GPIB controller or computer and may be either single or multiple messages.

6.5.2.1 Single Messages

Single messages are formatted as follows:

<Header> <Data> <Data Terminator> <Line Terminator>

Example: SS 150 MZ <CR> <LF>

Some front panel keys, such as SWEEP, require no data entries and therefore the GPIB entries consist of only the two character code without either data or data terminator. The format is:

<Header> <Line Terminator>

Example: DG <CR> <LF>

6.5.2.2 Multiple Messages

Multiple messages are formatted as follows:

<Header> <Data> <Data Terminator> <Separator> .....
<Header> <Data> <Data Terminator> <Line Terminator>

Example:	FA	10	MZ	,
	FB	200	MZ	<CR> <LF>

Header is a two character mnemonic code that corresponds to a front panel key or special function. Table 6-1 lists these codes. Examples are SS (step size) and FA (start frequency).

Data is a numerical value representing the quantity associated with the header. The value must be in the unscaled explicit radix point format and no exponent is allowed.

Data terminator must follow every data entry. The allowable terminators are: MZ (Megahertz), DB (Decibel), DG (Temperature Degrees), and ET (ENTER key). No other suffix is acceptable.

Line Terminator is used as a delimiter to indicate the end of the message. It is the CARRIAGE RETURN/LINE FEED sequence. Depending on how the controller is programmed, the LINEFEED may or may not be sent with the EOI line set true. Either method is acceptable to the 2075. In a computer where the program is written in a high level language such as BASIC, the terminators are inserted automatically and will not appear in the program line.

Separator is a convenience feature which makes for better readability by visually separating the components of a multiple message. The separator character may be either a comma or a space. If preferred, a separator need not be used at all. The following example shows three ways of entering the same multiple message. The message sets Start Frequency to 10 MHz, Stop Frequency to 100 MHz, Step Size to 10 MHz, Gain Upper Limit to 40 dB and Gain Lower Limit to 0 dB.

```
FA10MZ,FB100MZ,SS10MZ,UG40DB,LG0DB
FA10MZ FB100MZ SS10MZ UG40DB LG0DB
FA10MZFB100MZSS10MZUG40DBLG0DB
```

6.5.3 Measurement Messages

These are messages sent from the 2075 to the current listener on the bus. The messages are typically results obtained from DUT measurements. The 2075 must be either addressed to talk or set to talk-only (always) mode in order to send measurement messages and there must also be at least one listener on the bus. The 2075 remains configured to talk (talker active state) until it is unaddressed to talk by the controller or sent to the talker addressed state. In order to unaddress the 2075, the controller must send a universal untalk command, a different talk address, or an Abort message. Measurement messages are output to the bus as a set, where each set may contain one, two, or three pieces of data made up of the front panel displays A, B, and C; typically Noise Figure, Gain, and Frequency. The data sets selection are defined using Special Function 49.

The program loop should be written to input continuous data from the 2075. If only one set of data is required, then the program should untalk the 2075 after the first set is received.

6.5.3.1 Outputting Measurement Messages In Talk-Only Mode.

When the 2075 is in the Talk-Only mode, the instrument will send Data messages whenever the GPIB is in the data mode. When a measurement is completed, the results will be output to the bus unless the device that is listening is not ready to receive data. If not ready for data, another measurement cycle will automatically be executed.

If a controller is not available, but there is a GPIB compatible printer, it may be connected to the GPIB port (rear of 2075) and operated as follows:

1. Use Special Function 49 to select the output format.

2. Set the printer to Listen Only mode (or Listen Always mode).

3. Use Special Function 40.1 to set the 2075 to Talker Only (or Talk Always) mode.

The 2075 will start to send measurement data out to the printer until it is reset by Special Function 40.0.

6.5.3.2 Outputting Measurement Messages In Addressed-To-Talk Mode

This is the normal GPIB operating mode for the 2075 under the control of an external controller such as a computer. In this mode, the controller addresses the computer as a listener, addresses the 2075 as a talker, and then starts the data transfer. Refer to the controller manufacturer's manual for more details. A typical setup procedure is as follows:

1. Ensure that Special Function 40.0 has been selected.

2. In the program, set Special Function 49 to the required format (GPIB code F0 thru F6).

3. Set up all the necessary parameters for the 2075 using the appropriate GPIB codes (see Programming Messages).

4. The recommended protocol for receiving measurement data from the 2075 is as follows:

A. Send the 2075 an output format code (F0 thru F6) such that the correct number of variables that the controller wishes to receive will be sent by the 2075.

B. Address the 2075 to talk and the controller to listen and provide the correct number of variables to receive the 2075 data dictated by the format set up in Step A.

C. When the data is received, unaddress the 2075. If this is not done, the 2075 will remain in a talker active state and will repeatedly try to output data to the bus once per measurement cycle.

Example

The following program example illustrates the correct procedure and assumes the use of an HP 85 controller programmed in BASIC. The 2075 address is eight (8) and it is tuned to 100 MHz. Special Function 40.0 is in effect.

```
100 OUTPUT 708 ;"F0"  (Send F0 for output window C)
110 ENTER 708 ; N     (Enter 708 -- 1 variable)
120 SEND 7 ; UNT      (Untalk)
```

The above three lines correspond to Steps 4A, 4B, and 4C of the previous setup procedure.

6.5.3.3 Measurement Message Format

The messages can be of two types: single and multiple.

Single Messages

Single data item messages (GPIB codes F0, F1, and F2) are formatted as follows:

<Data> <Line Terminator>

Example: 5.65 <CR> <LF>

Multiple Messages

Multiple data item messages (GPIB codes F3 thru F6) are formatted as follows:

<Data> <Separator> <Data> <Separator> <Data> <Line terminator>

Example: 10 , 45.23 , 4.75 <CR> <LF>

Data is a numerical value in the unscaled explicit radix format with no exponent. The implied units are determined by the current settings of the 2075. Frequency is always MHz, Gain and Noise Figure is dB or Ratio as previously selected, Te is degrees Kelvin, and Y factor is dB or Ratio.

Line terminator is a RETURN followed by a LINE FEED (with EOI). These are generated by the 2075.

Separator may be selected (through a program message) to be any ASCII character or string of characters. This allows the normal comma (default) separator to be replaced by any other combination so that the requirements of any kind of controller can be met. If the data is output to a printer, for example, it would be convenient to define the separator as a string of spaces.

The program message ' ' (quote/space/quote) defines a space as a separator character. The program message '##' defines two # as the separator characters.

WARNING

SOME CONTROLLERS MAY ACCEPT ONLY THE "," (COMMA) AS A DATA SEPARATOR. UNLESS OTHER CHARACTERS WILL BE ACCEPTED, USE ONLY THE DEFAULT COMMA AS THE SEPARATOR.

The following are additional examples of multiple messages:

100,20.43,4.55	Freq 100 MHz, Gain 20.43 dB, NF 4.55 Ratio
200 -12.43 15.52	Separator is single space
250##18.65##14.54	Separator is ##

6.5.3.4 Error Conditions

In situations where the measured data is invalid, the GPIB measurement message will contain a numeric value and an exponent symbol (E) representing a number in the range of 100 thru 999. The presence of the E usually indicates an error condition and the numerical value is the error message number. The general form of the error message is XXXE10. The computer controller may change the format to X.XXE10. In some cases, this type of message is also used as an End Code.

The following are examples of error conditions:

100,1.71+E10,5.55	Error 171 — Data not available (for Gain)
350,1.70+E10,5.4	Error 170 — Measured data out of range

Please refer to Table 5-2 for a complete listing of error codes.

6.5.4 Status Messages

6.5.4.1 Require Service Message

The 2075 sends this message by setting the Service Request (SRQ) status line true. The message can be sent in either local or remote modes. The message is cleared when the controller executes a serial poll or if the 2075 receives a Clear message.

6.5.4.2 Enabling the Service Request

The following Special Function and GPIB codes can be used to enable the 2075 to issue the Require Service message for the following conditions:

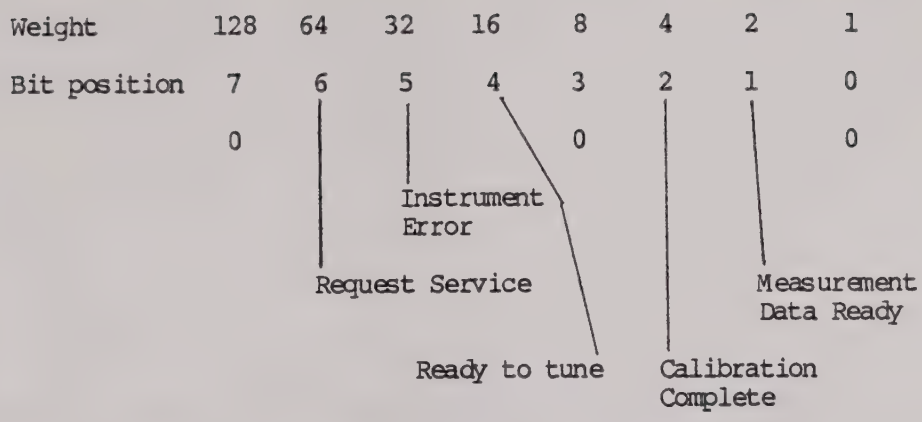
Special Function	GPIB Code	Condition
42.0	NI	All SRQ's disabled
42.1	RA	SRQ on "data ready"
43.1	RC	SRQ on "calibration complete"
45.1	RT	SRQ on "ready to tune"
46.1	RI	SRQ on instrument error

To enable the various conditions, send the appropriate GPIB Code as shown above. Each of the conditions must be enabled separately. To disable a particular condition, set the corresponding Special Function to zero or send the equivalent GPIB codes. It is recommended that the user place the 2075 in Measurement Cycle Pause (GPIB T1), prior to enabling an SRQ condition. When the controller is ready to receive and service the SRQ message, the user's software can enable the measurement cycle by sending the 2075 the code for Continue Measurement Cycle (GPIB T0). This avoids getting an SRQ before the controller is ready to service it.

6.5.4.3 Status Byte

When the 2075 requires the attention of the controller, it sets the SRQ line true. In response to the SRQ, the controller conducts a Serial Poll and reads the Status Byte from each device on the bus. The status message refers to the status byte that a device sends to the controller upon receipt of a Serial Poll. After reading the status byte, the controller knows who and what caused the SRQ.

In the status byte, five of the bits are set according to the enabled conditions shown in the previous table. If one or more of the five conditions are enabled, the RQS bit (bit 7) will be set true as well as the individual bits corresponding to the enabled conditions. The table on the following page shows the format of the Status Byte and the SRQ conditions:



The 2075 will not generate an SRQ unless one of the special functions 42 thru 46 has been enabled.

After the 2075 has received the Serial Poll Enable command (SPE), and is then addressed to talk (after SPE), it sends the Status Byte message.

After the Status Byte message has been sent it will be cleared if the Serial Poll Disable (SPD) command is received or if the 2075 is unaddressed to talk or if the Abort message is received. The Status Byte and any Require Service message will always be cleared if a Clear message is received.

6.5.4.4 Data Collection

The following flowchart (Figure 6-1) shows how data is collected using the Data Ready SRQ. Following the flowchart is an actual programming example using an HP 85 as a system controller (Figures 6-2 and 6-3). The first two pages are a printout of the program itself and the third page contains the program generated measurement results. The noise figure of the DUT is measured at 500 MHz and 600 MHz.

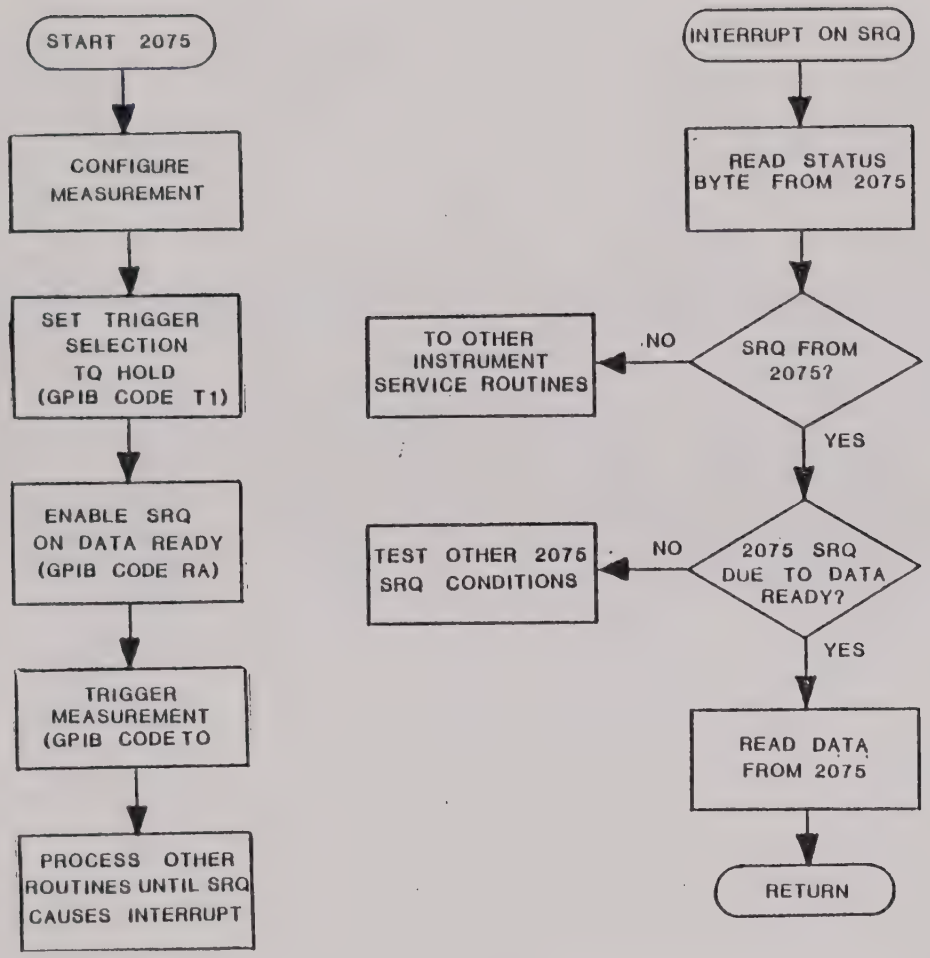


Figure 6-1. Flowchart Showing Data Collection using Data Ready SRQ

```
 10 !  PROGRAM TO DEMO SRQ
 20 !  ON DATA READY
 30 !  TRIGGED MEASUREMENT
 40 !
 50 !
 60 !  NORMAL NOISE MEASUREMENT
 70 !  FREQENCY OF MEAS 500 MHZ
 75 !          AND 600 MHZ
 80 !  SMOOTHING = 16
 90 !  DISPLAYS A AND C READ
100 !  PRINT DATA TO THERM PRT
110 !
120 ! FIRST STEP:
130 ! SET UP INTERRUPT
140 ! INITIALIZATION OF
145 ! HP 85 CONTROLLER
150 ON INTR 7 GOSUB 1000
160 ENABLE INTR 7;8
170 !
180 ! SECOND STEP:
190 ! COFIGURE 2075 MEASUREMENT
200 !
210 ! TUNE TO 500 MHZ
220 OUTPUT 708 ;"FR 500 MZ"
230 !
240 ! MEASUREMENT NOISE FIG
250 !
260 OUTPUT 708 ;"NF"
270 !
280 ! SET SMOOTHING FACTOR
290 OUTPUT 708 ;"S4"
300 !
310 ! SET DATA OUTPUT FORMAT
320 !
330 OUTPUT 708 ;"F4"
340 ! SEND TRIGGER CODE(HOLD)
350 !
360 OUTPUT 708 ;"T1"
370 !
380 !
390 ! WE ARE NOW READY TO MAKE
400 ! OUR MEASUREMENTS
410 !
420 ! STEP 3 SEND SRQ ON DATA
422 !       READY TO 2075
430 !
440 OUTPUT 708 ;"RA"
450 !
460 ! SEND TRRIGGER MESSAGE
470 ! AND PROCESS OTHER ROUTINES
480 ! UNTILL SRQ CAUSES INTERUPT
490 OUTPUT 708 ;"T0"
495 T=1
500 IF 1=1 THEN GOTO 500
510 END
```

Figure 6-2. Example Program for Data Collection using Data Ready SRQ with an HP 85 as a system controller.

```
900 ! SRQ SERVICE ROUTINES
910 ! IF SRQ THEN:
920 ! WHO SENT SRQ ?
930 ! WHY WAS SRQ SENT?
940 ! PROCESS INFOMATION AS
950 ! NECESSARY
960 !
970 !
980 ! STEP 1: WHO SENT SRQ
990 ! DO SERIAL POLL
1000 S=SPOLL(708)
1010 IF BIT(S,6)=1 THEN GOTO 200
     0
1020 ! ELSE POLL OTHER DEVICES
1030 ! ON BUSS
1040 GOTO 5000
2000 PRINT "2075 SENT SRQ"
2010 PRINT "TESTING CAUSE"
2020 IF BIT(S,1)=1 THEN GOTO 300
     0
2030 ! TEST OTHER BITS FOR
2040 ! OTHER POSSIBLE SRQ
2050 ! CAUSES
3000 PRINT "2075 SENT DATA READY
      SRQ"
3010 PRINT "READING 2075 DATA"
3020 ENTER 708 ; F,N
3030 SEND 7 ; UNT
3032 ! DISABLE DATA RDY SRQ
3034 OUTPUT 708 ;"NA"
3040 PRINT "DATA RECORD"
3050 PRINT "FREQ=",F,"MHZ"
3060 PRINT "NOISE FIG=",N,"DB"
3080 ! INITIALIZE HP 85 STATUS
3090 STATUS 7,1 ; S1
4000 ENABLE INTR 7;8
4010 IF T=1 THEN GOSUB 6000
5000 RETURN
6000 ! TUNE TO NEXT FREQ AND
6010 ! RE ENABLE SRQ ON DATA
6020 ! READY
6030 OUTPUT 708 ;"FR 600 MZ"
6035 T=2
6040 OUTPUT 708 ;"RA"
6050 RETURN
```

Figure 6-2. Example Program (contd).

```
2075 SENT SRQ
TESTING CAUSE
2075 SENT DATA READY SRQ
READING 2075 DATA
DATA RECORD
FREQ=                    500
MHZ
NOISE FIG=               5.18
DB
2075 SENT SRQ
TESTING CAUSE
2075 SENT DATA READY SRQ
READING 2075 DATA
DATA RECORD
FREQ=                    600
MHZ
NOISE FIG=               5.33
DB
```

Figure 6-3. Sample measurement results from running the program.

Table 6-1 2075 Summary of GPIB Codes

GPIB Code	Parameter
A0	Double Sideband
A1	Lower Single Sideband
A2	Upper Single Sideband
AF	Normal automatic frequency calibration
AQ	Display Gain (only) vs frequency on scope
B0	Use ENR TABLE 0 with nominal values
B1	Use ENR Table 1. User must enter
B2	Use ENR Table 2. User must enter
B3	Use ENR Table 3. User must enter
B4	Use ROM ENR Table. Special ROM required
C1	Use calibration setting #1
C2	Use calibration setting #2
C3	Use calibration setting #3
CA	Second Stage Calibration
CT	Clear ENR table in ENR mode
D1	DUT Configuration 1
D2	DUT Configuration 2
D3	DUT Configuration 3
D4	DUT Configuration 4
D5	DUT COnfiguration 5
D6	DUT Configuration 6
DB	Terminator for dB unit entries
DD	Blank all displays during measurement
DE	Normal measurement
DF	Disable automatic frequency calibration
DG	Terminator for degree unit entries
EF	Disable ENR entry mode
EN	Enable ENR entry mode
ET	General entry terminator code
F0	Output window C data only
F1	Output window B data only
F2	Output window A data only
F3	Output window A and B data
F4	Output window A and C data
F5	Output window B and C data
F6	Output window A, B, and C data
FA	START FREQ prefix
FB	STOP FREQ prefix
FC	Do a frequency calibration
FF	Front panel FIXED FREQ key
FG	X-out = NF/Y-out = gain on strip chart
FQ	Plot NF vs frequency on plotter
GD	Front panel Gain RATIO/dB key at dB setting
GF	Normal measurement (no time delay)
GQ	Plot gain vs frequency on plotter
GR	Front panel Gain RATIO/dB key at RATIO setting
GS	Time delay to ignite gas source (1 mSec)
I0	IF Autorange
I1	IF attenuator setting 1
I2	IF attenuator setting 2

Table 6-1 2075 Summary of GPIB Codes (contd.)

GPIB Code	Parameter
I3	IF attenuator setting 3
I4	IF attenuator setting 4
I5	IF attenuator setting 5
I6	IF attenuator setting 6
I7	IF attenuator setting 7
I8	IF attenuator setting 8
I9	IF attenuator setting 9
IA	IF attenmuator setting 10
IC	Execute IF attenuator calibration
IF	IF FREQ prefix
L1	Enter loss before the DUT (dB)
L2	Enter temperature of the losses
L3	Enter the loss after the DUT (dB)
LC	Use loss compensation (use with SF 18)
LD	Noise source lamp disable
LE	Noise source lamp enable
LG	Lower gain limit
LL	Move plotter pen to lower left
LN	LOWER LIMIT (NOISE) prefix
LO	LO FREQ prefix
MC	Prohibit NF/G measurements at non-calibrated points
MN	Use interpolation at non-calibrated points
MZ	Terminator for MHz unit entries
N0	Disable bandwidth compensation
N1	Bandwidth #1 prefix
N2	Bandwidth #2 prefix
N3	Enable bandwidth compensation
ND	Front panel NF RATIO/dB on dB setting
NE	Measure noise measure (m)
NF	Measure cascade noise figure
NG	Measure first stage noise figure and gain
NI	All SRQ's disabled
NP	Normal oscilloscope (NF and Gain vs Freq)
NQ	Display NF (only) vs Freq on oscilloscope
NR	Front panel NF RATIO/dB in RATIO setting
NS	Loss compensation off
OP	Measure operating noise temperature
P1	Display test pattern #1 on oscilloscope
P2	Display test pattern #2 on oscilloscope
PM	Power measurement (NS off)
PN	Power measurement (NS on)
R0	RF auto range
R1	RF attenuator setting 1
R2	RF attenuator setting 2
R3	RF attenuator setting 3
R4	RF attenuator setting 4
R5	RF attenuator setting 5
RA	SRQ on data ready
RC	SRQ on calibration complete

Table 6-1 2075 Summary of GPIB Codes (contd.)

GPIB Code	Parameter
RF	1 MHz frequency resolution
RI	SRQ on instrument error
RN	100 KHz frequency resolution
RT	SRQ on ready to tune
S0	Smoothing factor = 1
S1	Smoothing factor = 2
S2	Smoothing factor = 4
S3	Smoothing factor = 8
S4	Smoothing factor = 16
S5	Smoothing factor = 32
S6	Smoothing factor = 64
S7	Smoothing factor = 128
S8	Smoothing factor = 256
S9	Smoothing factor = 512
SC	Temperature units in Centigrade
SF	Temperature units in Farenheight
SG	SWEEP SINGLE
SK	Temperature units in Kelvin
SL	SECOND LO FREQ
SN	SWEEP off
SR	SWEEP AUTO
SS	STEP SIZE prefix
ST	Settling time
T0	Normal continuous measurement
T1	Hold measurement
T2	Execute one measurement cycle and hold
TC	T COLD (K) prefix
TE	Te measurement mode
TG	Te + G measurement mode
TH	T HOT (K) prefix
UG	UPPER LIMIT GAIN prefix
UN	UPPER LIMIT NOISE prefix
UR	Move plotter pen to upper right
V0	Normal measurement
V1	Display E-off in window A; RF attenuator setting in window B; IF attenuator setting in window C
V2	Display E-on in window A; RF attenuator setting in window B; IF attenuator setting in window C
YF	Y-factor for noise figure

Table 6-2 2075 Front Panel Keys and Equivalent GPIB Codes

Key #	Non-shifted Function	GPIB Code	Shifted Function	GPIB Code
1	PRESET	DC or SDC	N/A	
2	SPEC FUNCT	N/A	N/A	
3	SHIFT	N/A	N/A	
4	LOCAL	N/A	EXT LO ADDRESS	
5	UPPER LIMIT NOISE	UN	UPPER LIMIT GAIN	UG
6	LOWER LIMIT NOISE	LN	LOWER LIMIT GAIN	LG
7	START FREQ	FA	IF FREQ	IF
8	STOP FREQ	FB	LO FREQ	LO
9	SWEEP AUTO	SR	SWEEP SINGLE	SG
	Toggle SWEEP Off	SN	N/A	
10	STEP SIZE	SS	N/A	
11	FIXED FREQ	FF	Manual STEP SIZE	N/A
12	Increment ( )	N/A	EXT LO AMPLITUDE	N/A
13	Decrement ( )	N/A	SECOND LO FREQ	SL
14	ENR	EN	T HOT (K)	TH
	Toggle ENR Off	EF	N/A	
15	ON/OFF Cycle	N/A	T COLD (K)	TC
16	SEQuence	N/A	SET SEQUENCE	N/A
17	STORE	N/A	N/A	
18	RECALL	N/A	N/A	
19	- (minus)	"-"	N/A	
20	. (dec point)	"."	N/A	
21	0	0	N/A	
22	7	7	N/A	
23	4	4	N/A	
24	1	1	N/A	
25	8	8	N/A	
26	5	5	N/A	
27	2	2	N/A	
28	9	9	N/A	
29	6	6	N/A	
30	3	3	N/A	
31	RATIO or dB (Gain)	GR/GD	N/A	
32	CLEAR Entry	N/A	CLEAR ENR table	CT
33	ENTER	ET,MZ,DB,DG	N/A	
34	F + G	NG	Te + G	TG
35	F	NF	Te	TE
36	CALIB	CA	SINGLE FREQ calibrtn	
37	Dec Smoothing ( )	No direct equivalence ---		
38	Inc Smoothing ( )	use S0 thru S9.		
39	RATIO or dB (NF)	NR/ND	N/A	

DC = Device Clear. SDC = Selective Device Clear

The "Key #" is the position of the key on the front panel, counting top to bottom and left to right. It is also displayed during Special Function 31.2 (Keyboard Test).

Table 6-3. GPIB Function Reference Table

GPIB Message	Response	Related Commands & Controls	Interface Functions
Abort	The Noise-Gain Analyzer stops talking or listening.	IFC(UCG)	T5
Clear	The Noise-Gain Analyzer is set to the same conditions established by pressing PRESET. Refer to Tables 5-3 and 5-4.	DCL(ACG) SDC(UCG)	DC1
Clear Lockout/ Set Local	The Noise-Gain Analyzer returns to local (front panel control) and local lockout is cleared when the REN bus control line goes false. When entering local mode, no instrument settings or functions are changed.	REN(UCG)	RL1
Data	Most Noise-Gain Analyzer operations are bus programmable. All measurement results, special displays, and error outputs are available to the bus.		AH1 SH1 T5 L4
Local	The Noise-Gain Analyzer returns to local mode (front panel control). It responds equally to the GTL bus command and the front panel LOCAL key. When entering the local mode, no instrument settings or functions are changed.	GTL(ACG)	RL1
Local Lockout	Disables the LOCAL key so that only the controller can return the Noise Gain Analyzer to local.	LLO(UCG)	RL1
Remote	The instrument is allowed to enter the Remote mode when the REN bus control line is true. However, remote mode is not entered until the first time it is addressed to listen. The front panel REMOTE annunciator lights when the instrument is actually in the remote mode. When entering the remote mode, no instrument settings or functions are changed, but all front panel keys except LOCAL are disabled. All instrument control now comes from the GPIB.	REN(UCG)	RL1

Table 6-3. GPIB Function Reference Table (Cont.)

GPIB Message	Response	Related Commands & Controls	Interface Functions
Require Service	The Noise-Gain Analyzer sets the SRQ bus control line true to request service for the controller based on certain conditions specified in Special Functions 41 thru 45.	SRQ	SR1
Serial Poll	The Noise-Gain Analyzer responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit byte when addressed to talk. If the instrument is holding the SRQ control line true (issuing Require Service message), bit 7 (RQS bit) in the Status Byte and the bit representing the condition causing the Require Service message to be issued will both be true. The bits in the Status Byte are latched but can be cleared by: 1. Removing the causing condition, and 2. Reading the Status Byte.	SPE(ACG) SPD(ACG)	T5
Trigger	If in remote and addressed to listen, the Noise-Gain Analyzer makes one measurement according to previously programmed setup. It responds equally to bus command GET and program code T2, Trigger Execute (a Data message). Before using Trigger, the instrument should first be set to a Hold mode using program code T1.	GET(UCG)	DT1

* Commands, Control lines, and Interface Functions are defined in IEEE 488-1978. Knowledge of these may not be necessary if your controller's manual describes programming in terms of the eleven GPIB Messages shown in the left column, or a similar program command.

* ACG = Addressed Command Group. UCG = Universal Command Group.

US ASCII Character Codes

ASCII Char.	EQUIVALENT FORMS				GPIB
	Dec	Binary	Oct	Hex	
NUL	0	00000000	000	00	
SOH	1	00000001	001	01	GTL
STX	2	00000010	002	02	
ETX	3	00000011	003	03	
EOT	4	00000100	004	04	SDC
ENQ	5	00000101	005	05	PPC
ACK	6	00000110	006	06	
BEL	7	00000111	007	07	
BS	8	00001000	010	08	GET
HT	9	00001001	011	09	TCT
LF	10	00001010	012	0A	
VT	11	00001011	013	0B	
FF	12	00001100	014	0C	
CR	13	00001101	015	0D	
SO	14	00001110	016	0E	
SI	15	00001111	017	0F	
DLE	16	00010000	020	10	
DC1	17	00010001	021	11	LLO
DC2	18	00010010	022	12	
DC3	19	00010011	023	13	
DC4	20	00010100	024	14	DCL
NAK	21	00010101	025	15	PPU
SYNC	22	00010110	026	16	
ETB	23	00010111	027	17	
CAN	24	00011000	030	18	SPE
EM	25	00011001	031	19	SPD
SUB	26	00011010	032	1A	
ESC	27	00011011	033	1B	
FS	28	00011100	034	1C	
GS	29	00011101	035	1D	
RS	30	00011110	036	1E	
US	31	00011111	037	1F	

ASCII Char.	EQUIVALENT FORMS				GPIB
	Dec	Binary	Oct	Hex	
space	32	00100000	040	20	LA0
!	33	00100001	041	21	LA1
"	34	00100010	042	22	LA2
#	35	00100011	043	23	LA3
$	36	00100100	044	24	LA4
%	37	00100101	045	25	LA5
&	38	00100110	046	26	LA6
'	39	00100111	047	27	LA7
(	40	00101000	050	28	LA8
)	41	00101001	051	29	LA9
*	42	00101010	052	2A	LA10
+	43	00101011	053	2B	LA11
,	44	00101100	054	2C	LA12
-	45	00101101	055	2D	LA13
.	46	00101110	056	2E	LA14
/	47	00101111	057	2F	LA15
0	48	00110000	060	30	LA16
1	49	00110001	061	31	LA17
2	50	00110010	062	32	LA18
3	51	00110011	063	33	LA19
4	52	00110100	064	34	LA20
5	53	00110101	065	35	LA21
6	54	00110110	066	36	LA22
7	55	00110111	067	37	LA23
8	56	00111000	070	38	LA24
9	57	00111001	071	39	LA25
:	58	00111010	072	3A	LA26
;	59	00111011	073	3B	LA27
<	60	00111100	074	3C	LA28
=	61	00111101	075	3D	LA29
>	62	00111110	076	3E	LA30
?	63	00111111	077	3F	UNL

Table 6-4

ASCII Char.	EQUIVALENT FORMS				GPIB
	Dec	Binary	Oct	Hex	
@	64	01000000	100	40	TA0
A	65	01000001	101	41	TA1
B	66	01000010	102	42	TA2
C	67	01000011	103	43	TA3
D	68	01000100	104	44	TA4
E	69	01000101	105	45	TA5
F	70	01000110	106	46	TA6
G	71	01000111	107	47	TA7
H	72	01001000	110	48	TA8
I	73	01001001	111	49	TA9
J	74	01001010	112	4A	TA10
K	75	01001011	113	4B	TA11
L	76	01001100	114	4C	TA12
M	77	01001101	115	4D	TA13
N	78	01001110	116	4E	TA14
O	79	01001111	117	4F	TA15
P	80	01010000	120	50	TA16
Q	81	01010001	121	51	TA17
R	82	01010010	122	52	TA18
S	83	01010011	123	53	TA19
T	84	01010100	124	54	TA20
U	85	01010101	125	55	TA21
V	86	01010110	126	56	TA22
W	87	01010111	127	57	TA23
X	88	01011000	130	58	TA24
Y	89	01011001	131	59	TA25
Z	90	01011010	132	5A	TA26
[	91	01011011	133	5B	TA27
\	92	01011100	134	5C	TA28
]	93	01011101	135	5D	TA29
^	94	01011110	136	5E	TA30
_	95	01011111	137	5F	UNT

ASCII Char.	EQUIVALENT FORMS				GPIB
	Dec	Binary	Oct	Hex	
`	96	01100000	140	60	SC0
a	97	01100001	141	61	SC1
b	98	01100010	142	62	SC2
c	99	01100011	143	63	SC3
d	100	01100100	144	64	SC4
e	101	01100101	145	65	SC5
f	102	01100110	146	66	SC6
g	103	01100111	147	67	SC7
h	104	01101000	150	68	SC8
i	105	01101001	151	69	SC9
j	106	01101010	152	6A	SC10
k	107	01101011	153	6B	SC11
l	108	01101100	154	6C	SC12
m	109	01101101	155	6D	SC13
n	110	01101110	156	6E	SC14
o	111	01101111	157	6F	SC15
p	112	01110000	160	70	SC16
q	113	01110001	161	71	SC17
r	114	01110010	162	72	SC18
s	115	01110011	163	73	SC19
t	116	01110100	164	74	SC20
u	117	01110101	165	75	SC21
v	118	01110110	166	76	SC22
w	119	01110111	167	77	SC23
x	120	01111000	170	78	SC24
y	121	01111001	171	79	SC25
z	122	01111010	172	7A	SC26
{	123	01111011	173	7B	SC27
|	124	01111100	174	7C	SC28
}	125	01111101	175	7D	SC29
~	126	01111110	176	7E	SC30
DEL	127	01111111	177	7F	SC31

Section VII

SCHEMATIC DIAGRAMS

7.1 INTRODUCTION

This section contains schematic diagrams for each assembly. The diagrams are presented in ascending assembly number order.

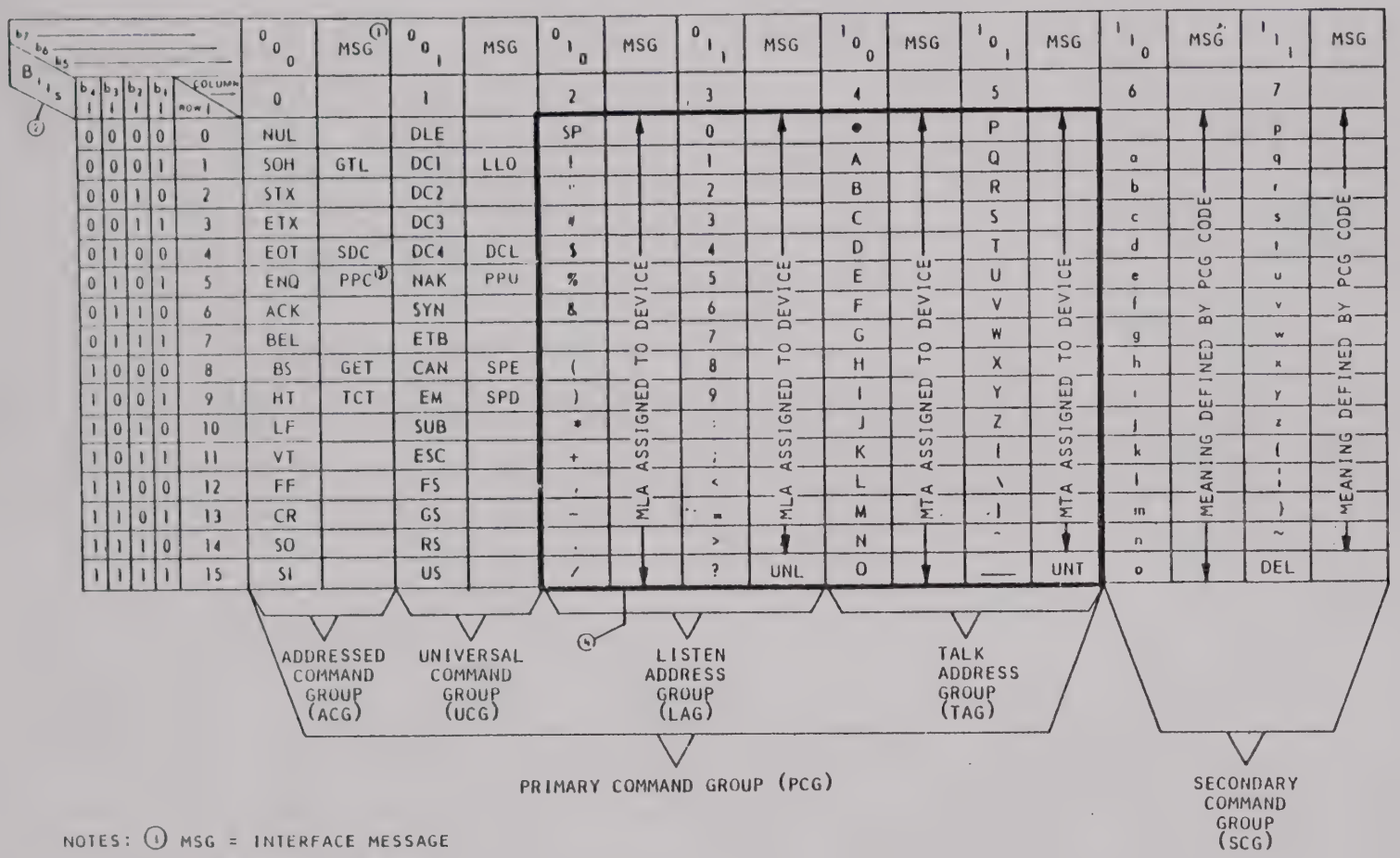
Appendix A

GPIB RELATED INFORMATION

A.1 INTRODUCTION

This section contains information related to the operation of the General Purpose Interface Bus.

(SENT AND RECEIVED WITH ATN=1)



NOTES: (1) MSG = INTERFACE MESSAGE
(2) b_1 = DIO1...b_7 = DIO7
(3) REQUIRES SECONDARY COMMAND
(4) DENSE SUBSET (COLUMN 2 THROUGH 5)

Multiline Interface Messages: ISO Code Representation

Multiline Interface Messages: ISO-7 Bit Code Representation

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CLASS CODE

METRIC CONVERSION TABLE

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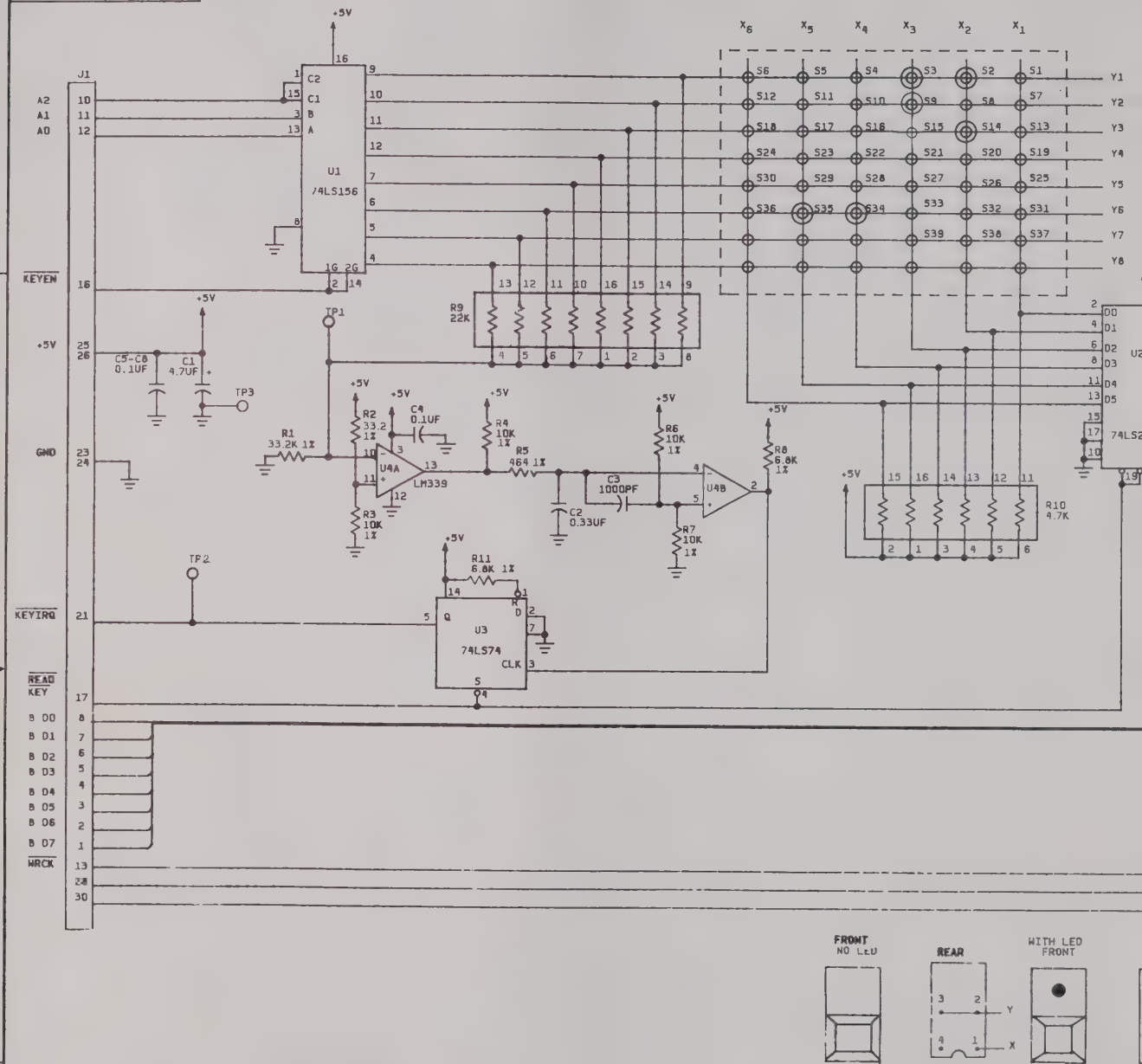

TYPICAL KEYSWITCH PIN OUT

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
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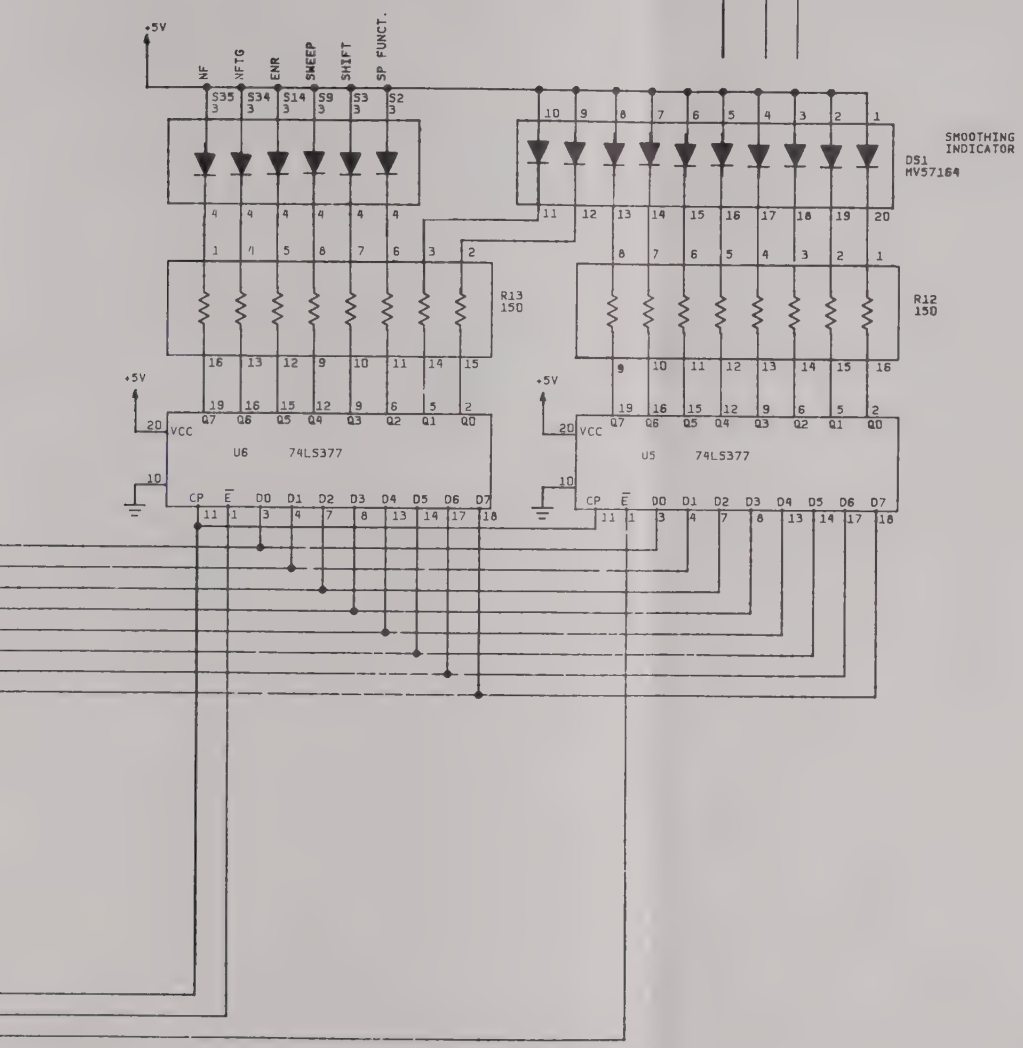


-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL ANGULAR
2 PLACE ± ±
3 PLACE ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.

	NAME	DATE
DRAWN	P. BISHOP	1-16-84
CHECK	[illegible]	1/21/84
ELEC ENGR	[illegible]	1/7/84
MECH ENGR	[illegible]	1/1/84
APPROVED	[illegible]	2-16-84

SCHEMATIC NO

NEXT ASSEMBLY NO 4-006346

EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation Division
Los Angeles Calif

KEY BOARD

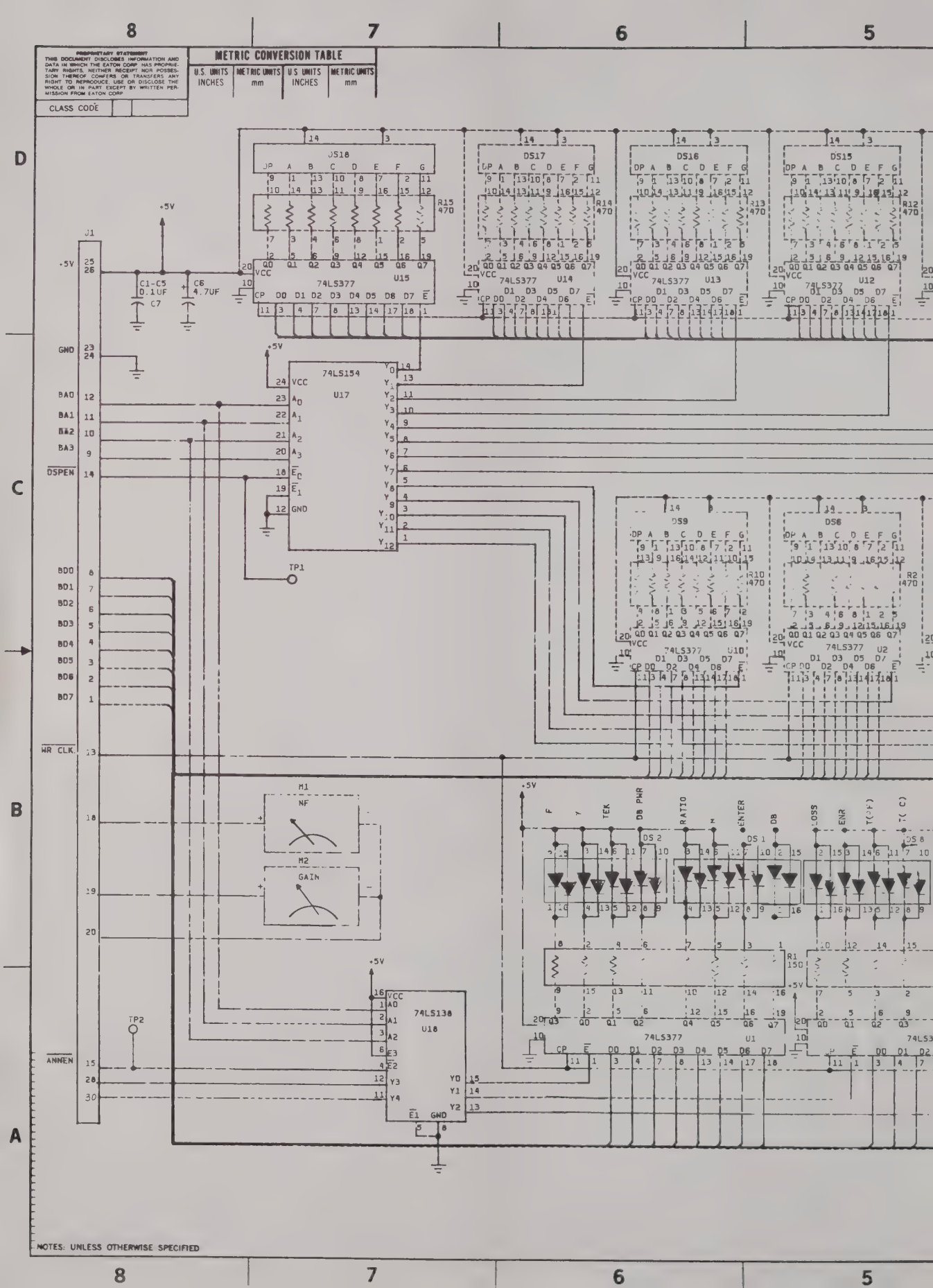
A1A1

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501903	A

SCALE

SHEET 1 OF 1

4-501903 A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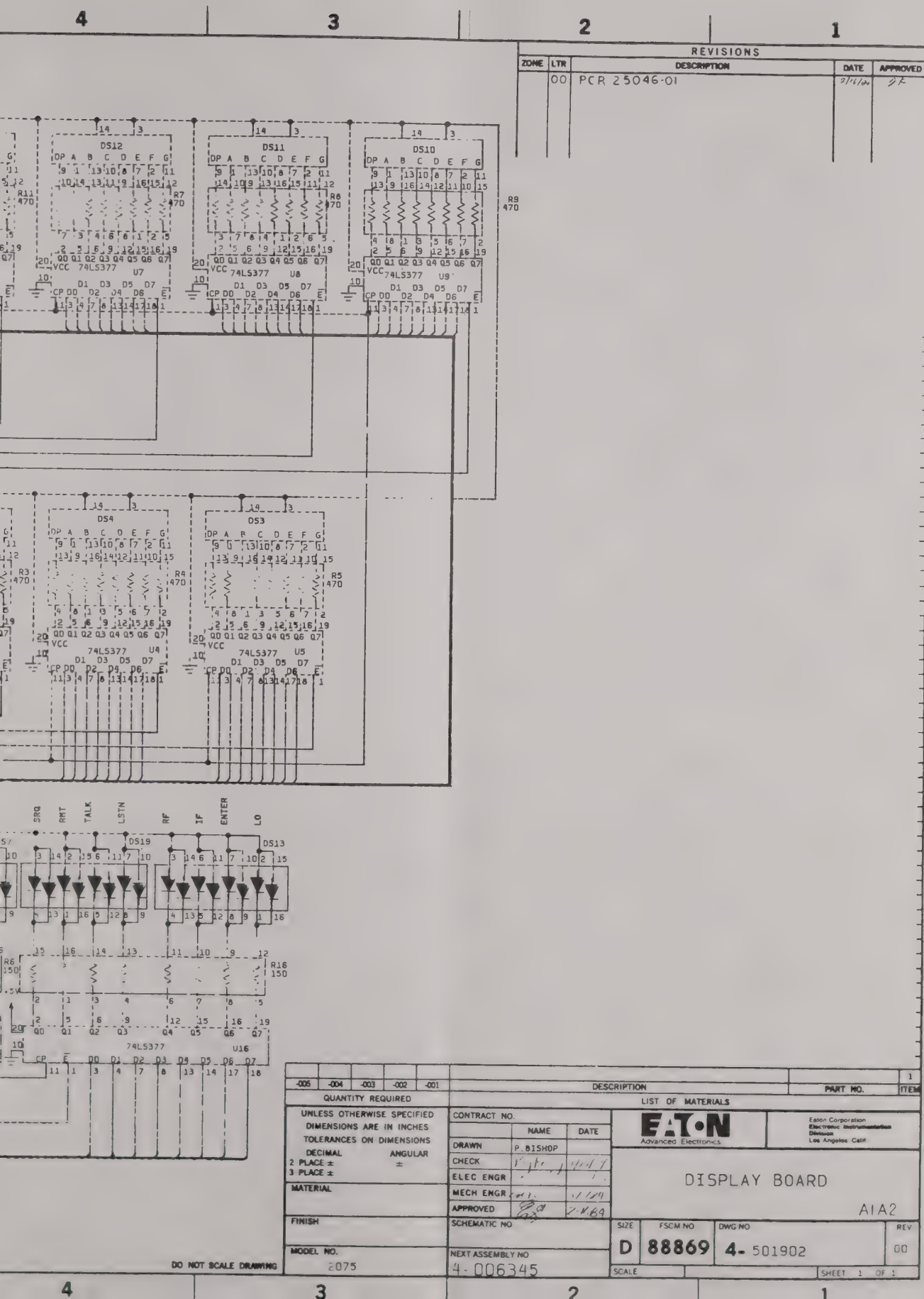
CLASS CODE
METRIC CONVERSION TABLE
U.S. UNITS INCHES
METRIC UNITS mm
U.S UNITS INCHES
METRIC UNITS mm
8
7
6
5
D
C
B
A
DS18
DS17
DS16
DS15
DS9
DS8
DS 1
DS 2
DS 8
R15 470
R14 470
R13 470
R12 470
R10 470
R2 470
R1 150
J1
+5V
GND
C1-C5 0.1UF
C7
C6 4.7UF
74LS377
U15
U14
U13
U12
U10
U2
U1
74LS154
U17
74LS138
U18
BA0
BA1
BA2
BA3
OSPEN
BD0
BD1
BD2
BD3
BD4
BD5
BD6
BD7
WR CLK.
ANNEN
TP1
TP2
M1
NF
M2
GAIN
F
Y
TEK
DB PWR
RATIO
ENTER
DB
LOSS
ENR
NOTES: UNLESS OTHERWISE SPECIFIED


4
3
2
1
REVISIONS
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D
C
B
A
DS12
DS11
DS10
DS4
DS3
DS19
DS13
74LS377
U7
U8
U9
U4
U5
U16
R3 470
R4 470
R5 470
R6 150
R7 470
R8 470
R9 470
R11 470
R16 150
SRQ
RMT
TALK
LSTN
RF
IF
ENTER
LO
4-501902 00
-005 -004 -003 -002 -001
QUANTITY REQUIRED
DESCRIPTION
PART NO.
ITEM
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL
2 PLACE ±
3 PLACE ±
ANGULAR ±
MATERIAL
FINISH
MODEL NO. 2075
DO NOT SCALE DRAWING
CONTRACT NO.
NAME DATE
DRAWN P. BISHOP
CHECK
ELEC ENGR
MECH ENGR
APPROVED
SCHEMATIC NO.
NEXT ASSEMBLY NO 4-006345
EATON Advanced Electronics
Eaton Corporation Electronic Instrumentation Division Los Angeles Calif
DISPLAY BOARD
A1A2
SIZE D
FSCM NO 88869
DWG NO 4-501902
REV 00
SCALE
SHEET 1 OF 1

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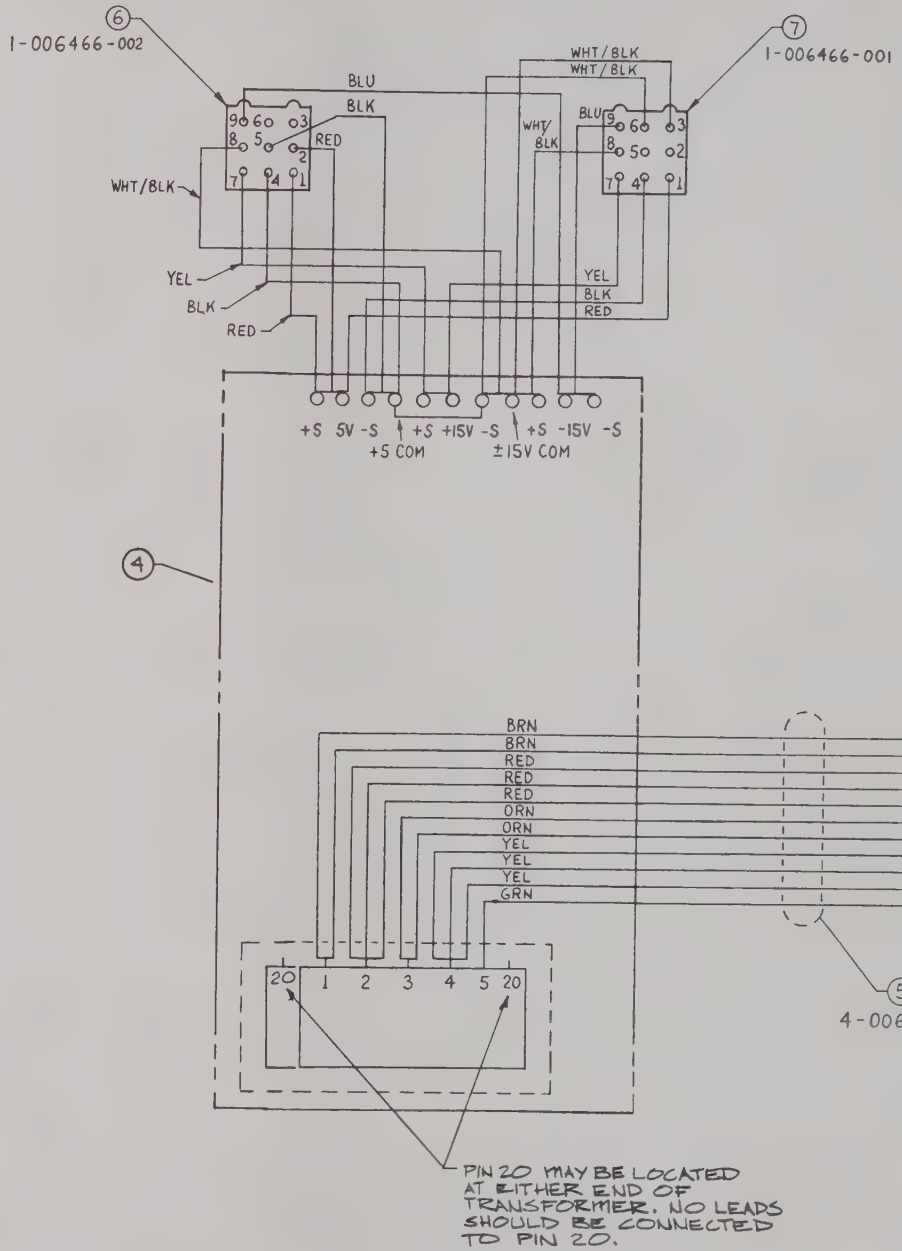
METRIC CONVERSION TABLE			
U S UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm

CLASS CODE | 12 | 18020



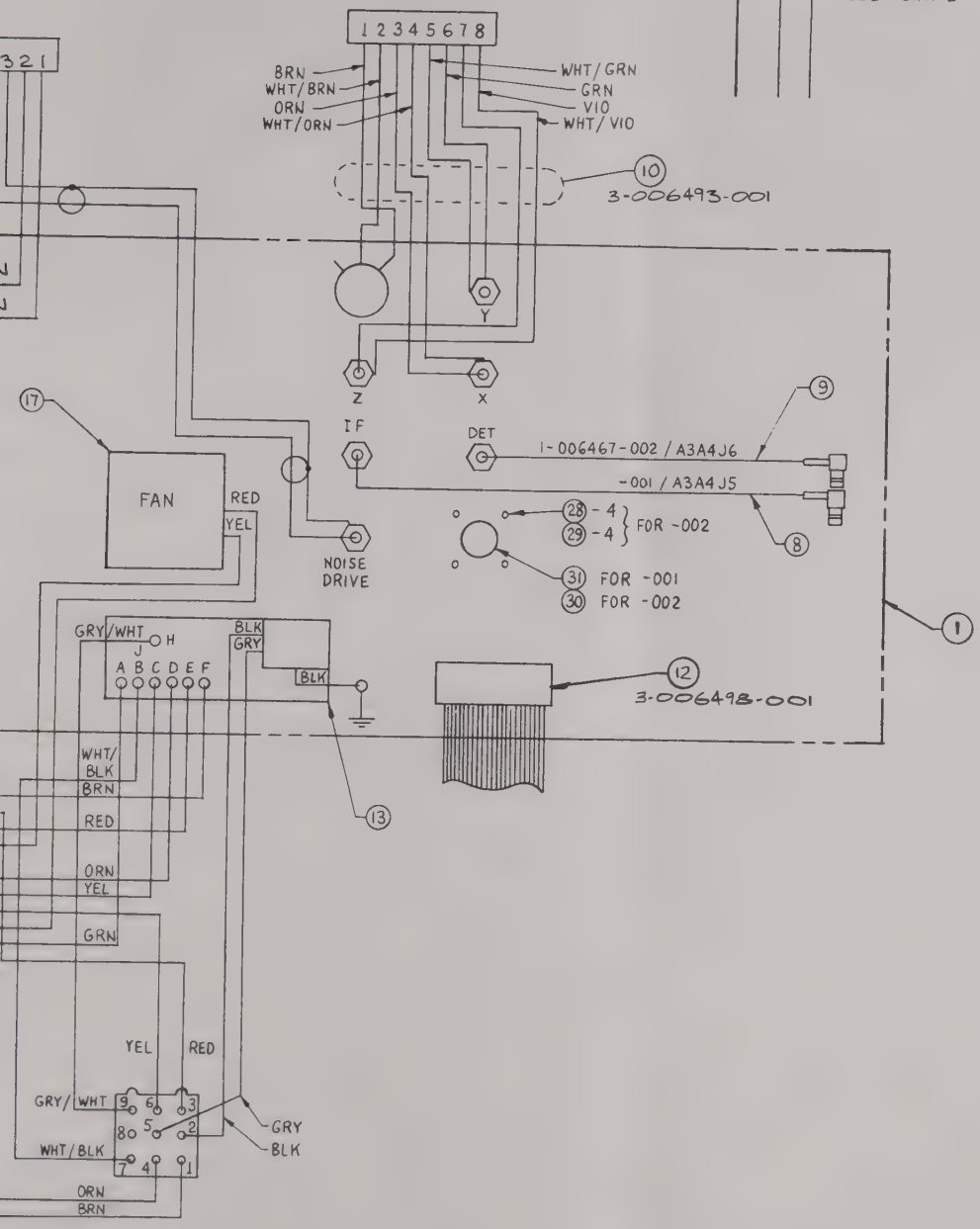
SHEET 3

WIRING DIAGRAM

1. ALL ITEM NUMBERS SHOWN ON THIS PAGE ARE REF.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		SEE SHT. 1		



-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± — 3 PLACE ± —
ANGULAR ± —

MATERIAL: P/L

FINISH: —

MODEL NO.: 2075

DO NOT SCALE DRAWING

CONTRACT NO.

	NAME	DATE
DRAWN	L ADAM	10 14 83
CHECK	[illegible]	10-17-83
ELEC ENGR	[illegible]	10-17-83
MECH ENGR	[illegible]	10-20-83
APPROVED	[illegible]	10-20

SCHEMATIC NO.

NEXT ASSEMBLY NO.: SEE TABLE

EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation
Division
Los Angeles Calif

REAR PANEL ASSEMBLY

A1A5

SIZE	FSCM NO	DWG NO	REV
D	88869	4-006462	A

SCALE —

SHEET 3 OF 3

4-006462 A

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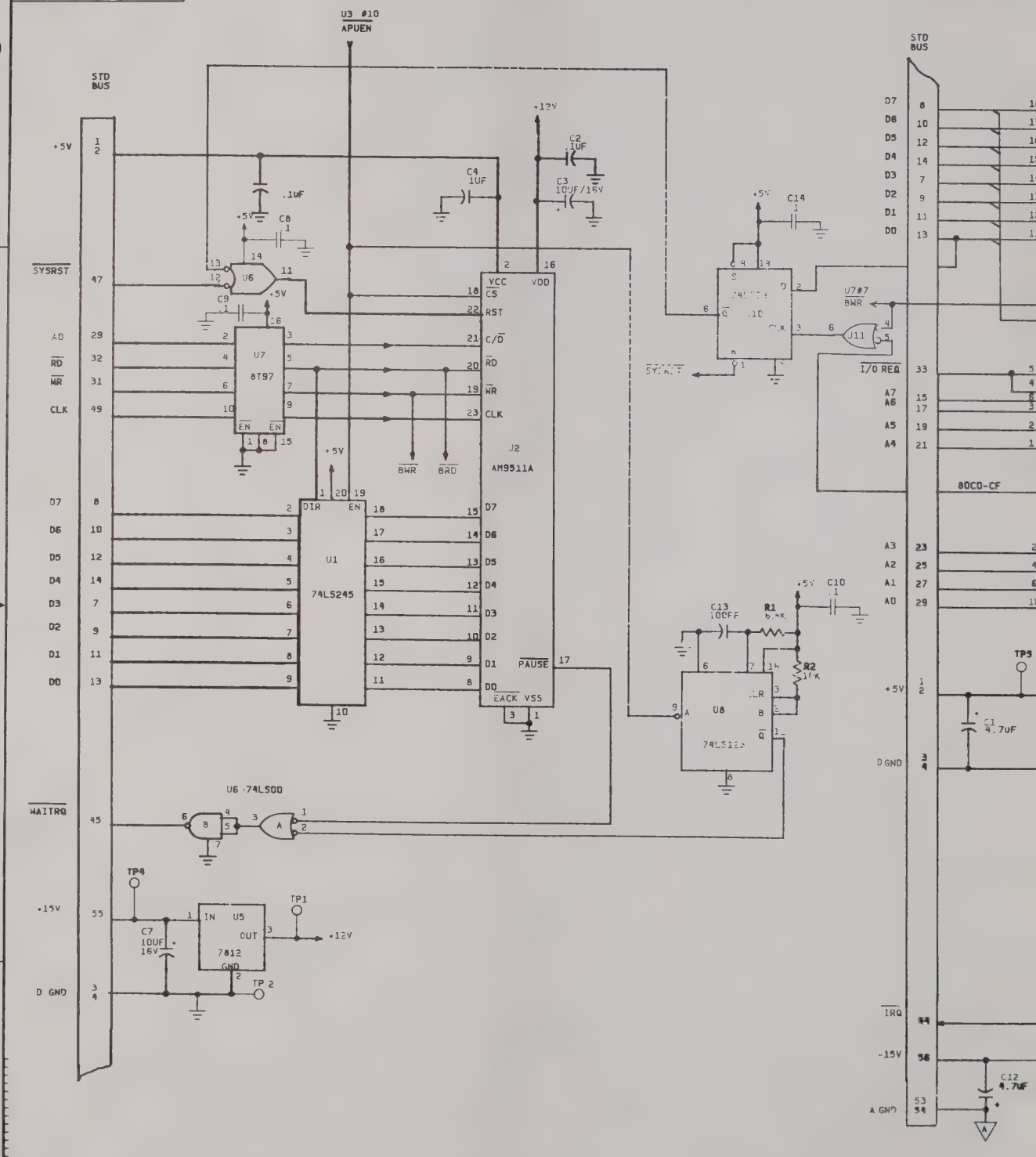
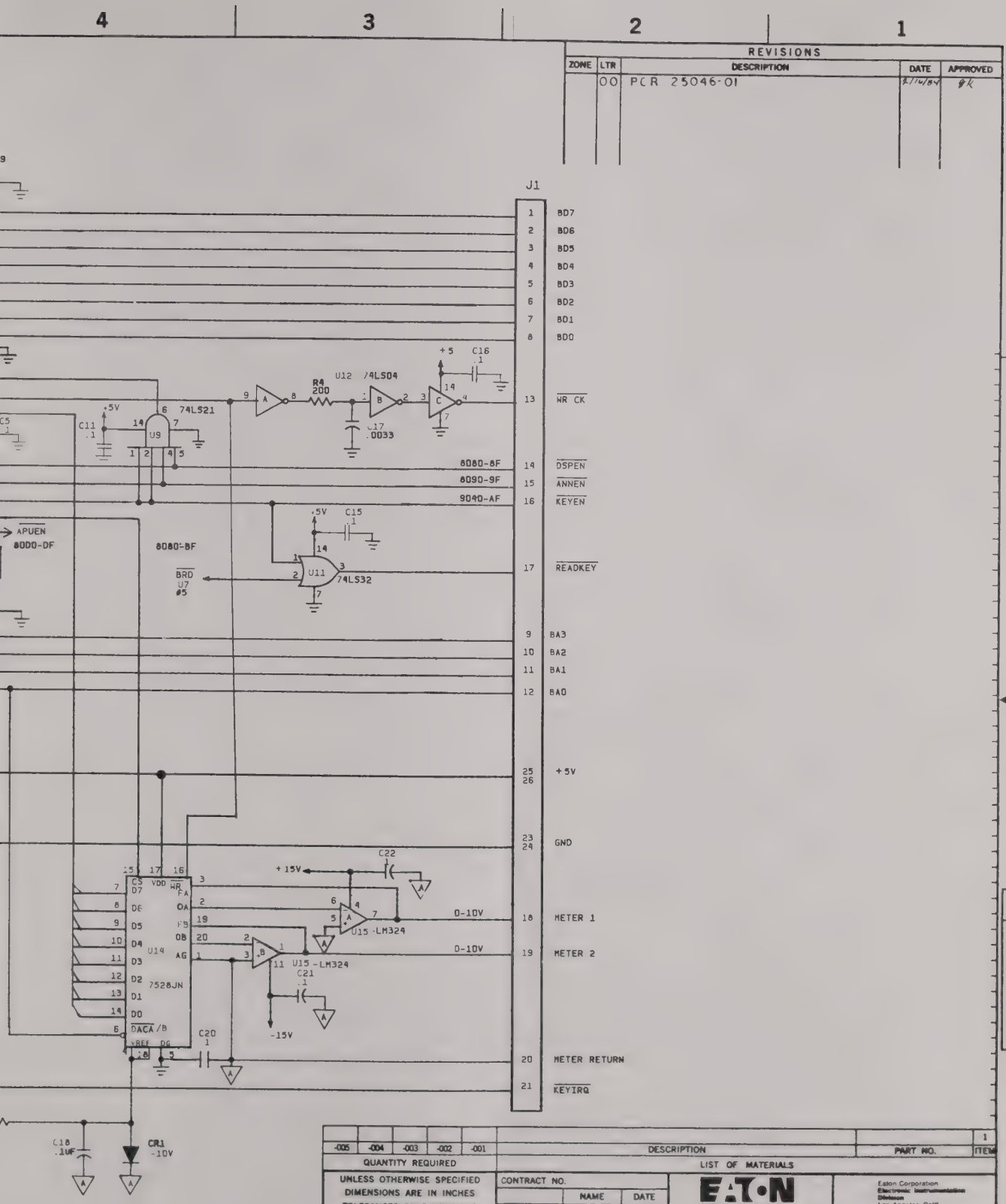
CLASS CODE

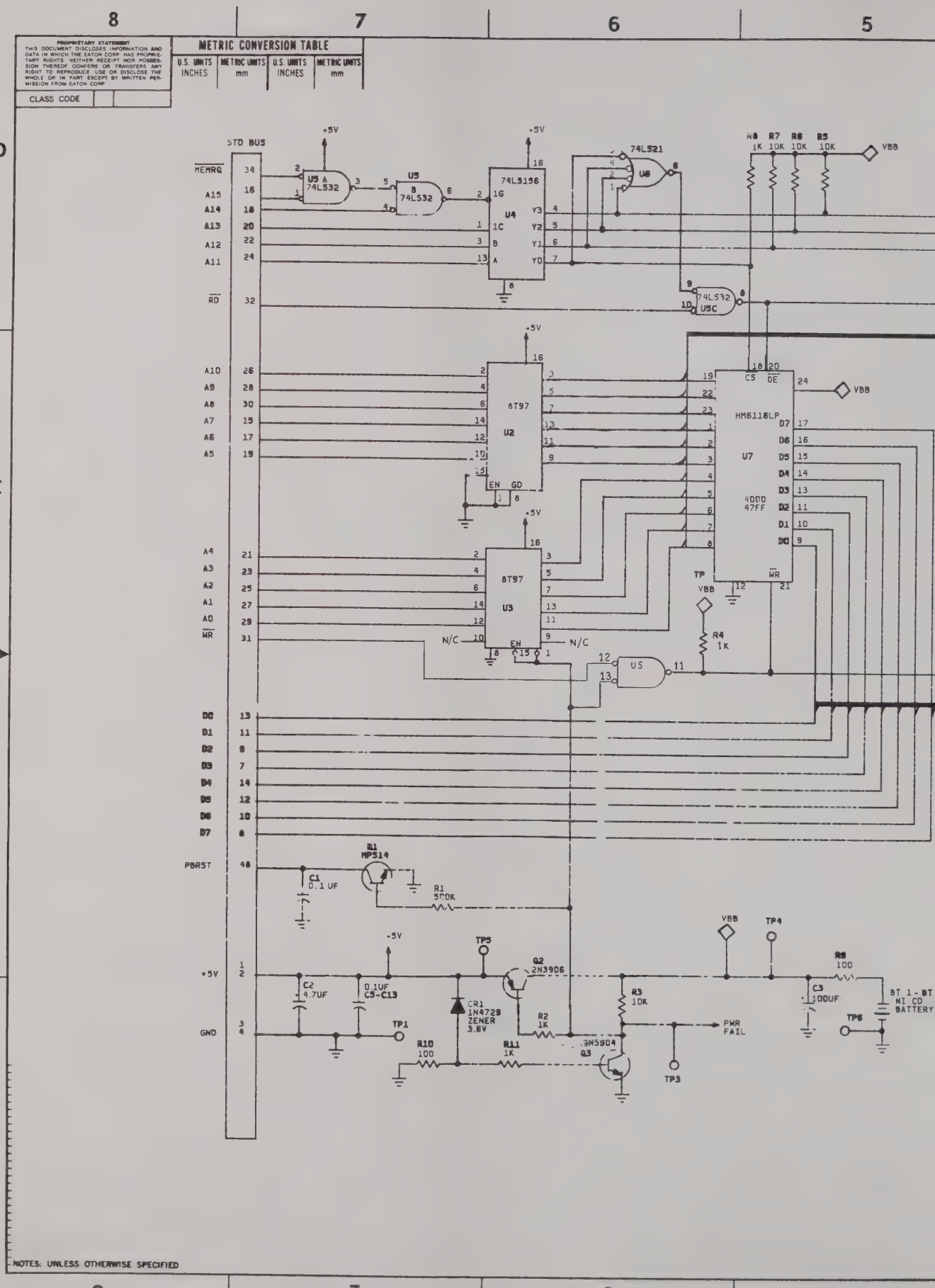
METRIC CONVERSION TABLE

U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm



NOTES: UNLESS OTHERWISE SPECIFIED


REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
00 PCR 25046-01 2/14/84
J1
1 BD7
2 BD6
3 BD5
4 BD4
5 BD3
6 BD2
7 BD1
8 BD0
13 WR CK
14 DSPEN
15 ANNEN
16 KEYEN
17 READKEY
9 BA3
10 BA2
11 BA1
12 BA0
25 +5V
26
23 GND
24
18 METER 1
19 METER 2
20 METER RETURN
21 KEYIRQ
U12 74LS04
U9 74LS21
U11 74LS32
U14 7528JN
U15 - LM324
R4 200
C11 .1
C15 .1
C16 .1
C17 .0033
C18 .1uF
C20 1
C21 .1
C22
CR1 -10V
+5V
+15V
-15V
0-10V
8080-8F
8090-9F
9040-AF
8000-DF
APUEN
BRD U7 #5
DO NOT SCALE DRAWING
MODEL NO. 2075
NEXT ASSEMBLY NO 4-006343
FINISH
MATERIAL
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL 2 PLACE ± 3 PLACE ± ANGULAR ±
QUANTITY REQUIRED -005 -004 -003 -002 -001
DESCRIPTION PART NO. ITEM
LIST OF MATERIALS
CONTRACT NO.
NAME DATE
DRAWN P.B. 10-10-83
CHECK 2/21/84
ELEC ENGR
MECH ENGR 2-1-84
APPROVED 2-16-84
SCHEMATIC NO.
EATON Advanced Electronics
Eaton Corporation Electronic Instrumentation Division Los Angeles, Calif.
FRONT, PANEL INTERFACE AND APU
A2A1
SIZE D FSCM NO 88869 DWG NO 4-501900 REV 00
SCALE
SHEET 1 OF 1
4-501900 00



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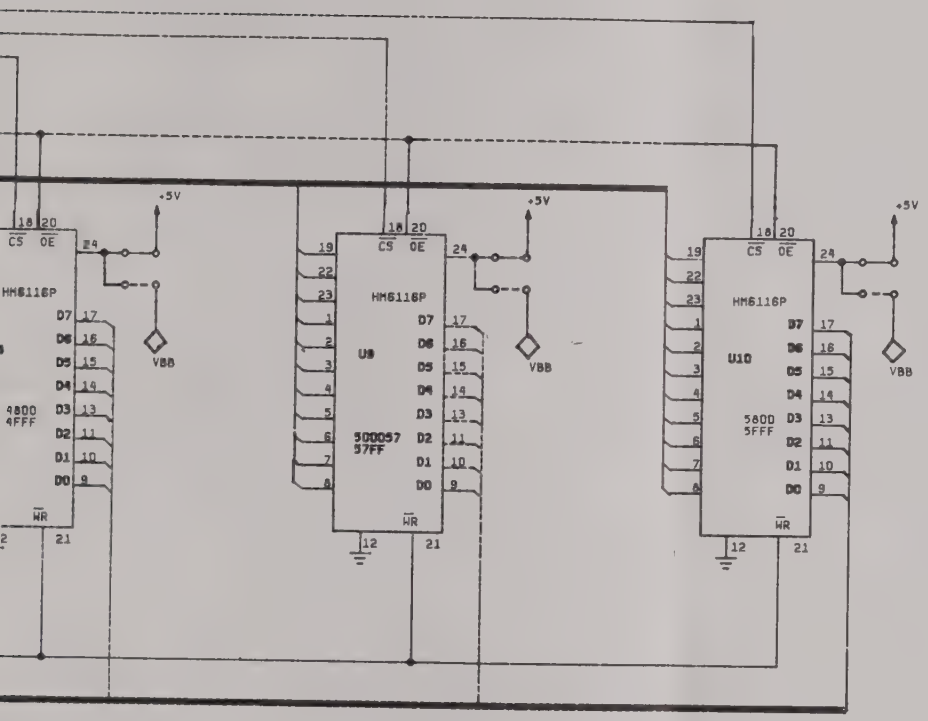
CLASS CODE
METRIC CONVERSION TABLE
U.S. UNITS INCHES
METRIC UNITS mm
U.S. UNITS INCHES
METRIC UNITS mm
STD BUS
MEMRQ
A15
A14
A13
A12
A11
RD
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
WR
D0
D1
D2
D3
D4
D5
D6
D7
PBRST
+5V
GND
U5 A 74LS32
U5 B 74LS32
74LS156
U4
74LS21
U6
74LS32
U5C
8T97
U2
8T97
U3
HM6116LP
U7
4000 47FF
R8 1K
R7 10K
R6 10K
R5 10K
VBB
TP
R4 1K
US
Q1 MPS14
C1 0.1 UF
R1 500K
C2 4.7UF
0.1UF C5-C13
CR1 1N4729 ZENER 3.6V
Q2 2N3906
R2 1K
R3 10K
R10 100
R11 1K
2N5904 Q3
PWR FAIL
TP1
TP3
TP4
TP5
TP6
R9 100
C3 100UF
BT 1 - BT NI CD BATTERY
NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	CO			
	A			
	B	PCR/EO 24873-01	10-7	
	C	PCR/ECO 25011-01		



-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ± ANGULAR ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

	NAME	DATE
CONTRACT NO.		
DRAWN	P. BISHOP	10-8-83
CHECK		
ELEC ENGR		1/1/84
MECH ENGR		
APPROVED		2-KBA
SCHEMATIC NO		
NEXT ASSEMBLY NO		

EATON Advanced Electronics

Eaton Corporation Electronic Instrumentation Division Los Angeles Calif

BATTERY BACK UP RAM CARD
A2A2

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501901	C

SCALE

SHEET 1 OF 1

4-501901 C

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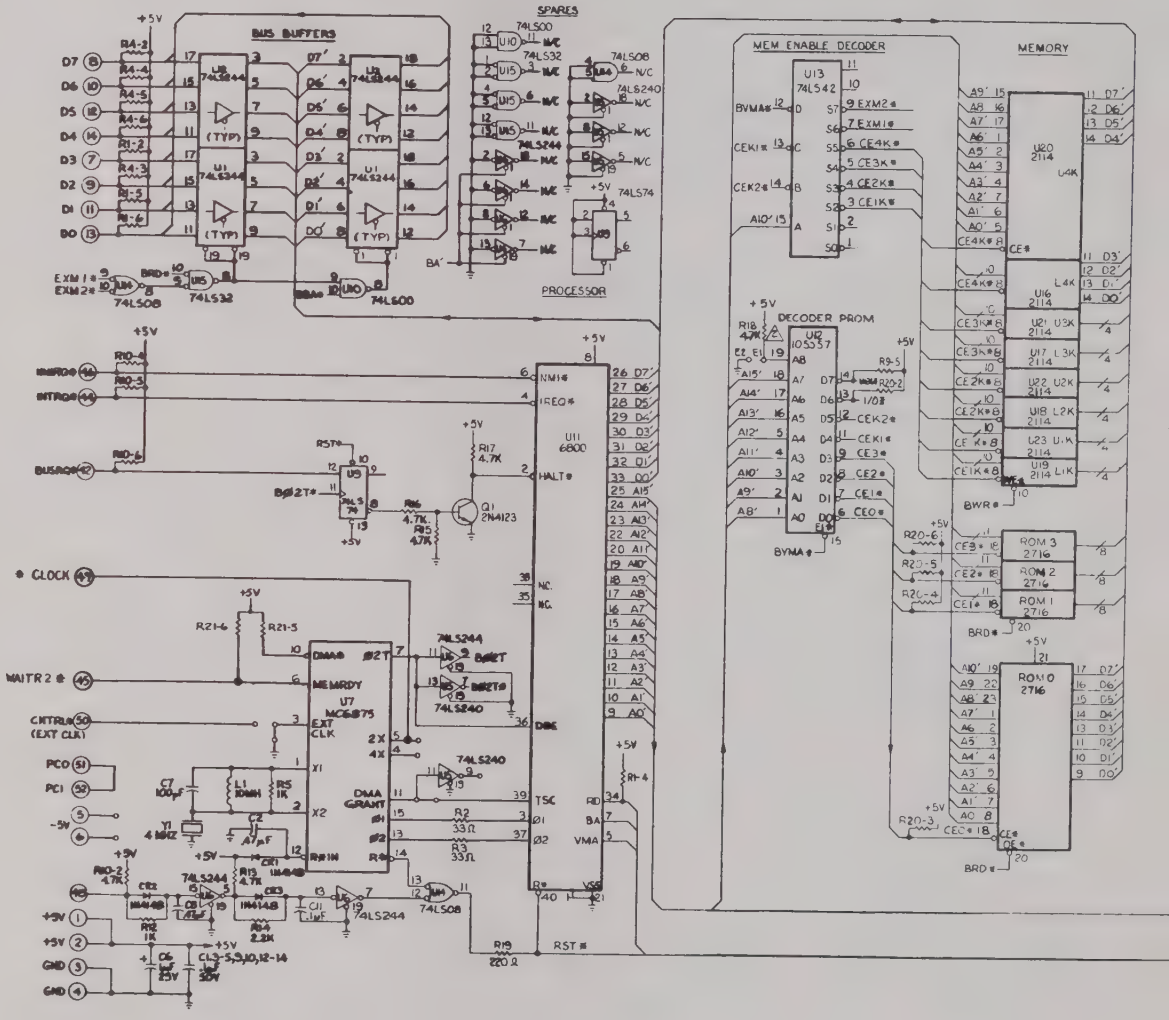
CLASS CODE

METRIC CONVERSION TABLE

U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm

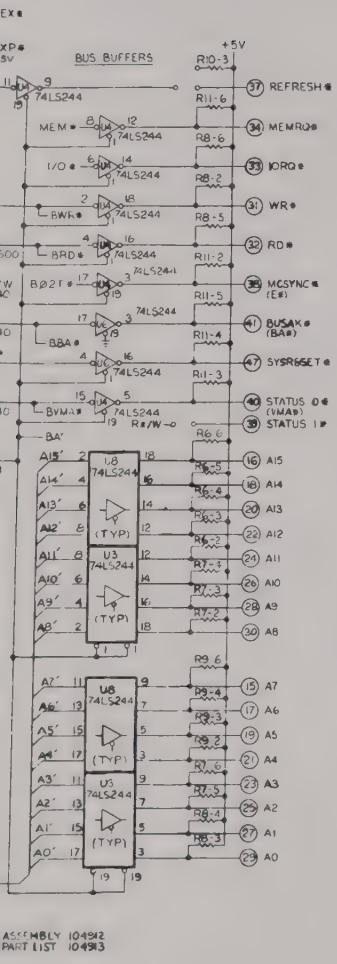


2 CUT TRACE FOR ALTERNATE MAPPING.

1. ALL RESISTORS ARE 4.7 K UNLESS OTHERWISE SPECIFIED.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	PCR/EO 25070-01	3-7-84	HK



ASSEMBLY 104912
PART LIST 104913

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL 2 PLACE ± — 3 PLACE ± — ANGULAR ± —	CONTRACT NO.	
	NAME / DATE	
	DRAWN — L.A. — 2.23.84	
	CHECK	
	ELEC ENGR 3-6-84	
MATERIAL —	MECH ENGR 3-5-84	
	APPROVED 3-7-84	
FINISH —	SCHEMATIC NO. —	
MODEL NO. 2075	NEXT ASSEMBLY NO 4-006514-001	

DO NOT SCALE DRAWING

EATON Advanced Electronics

Eaton Corporation Electronic Instrumentation Division Los Angeles Calif

SCHEMATIC, 7802 PROCESSOR CARD 6800 CPU

A2A3

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501930-001	00

SCALE — SHEET 1 OF 1

4-501930 00

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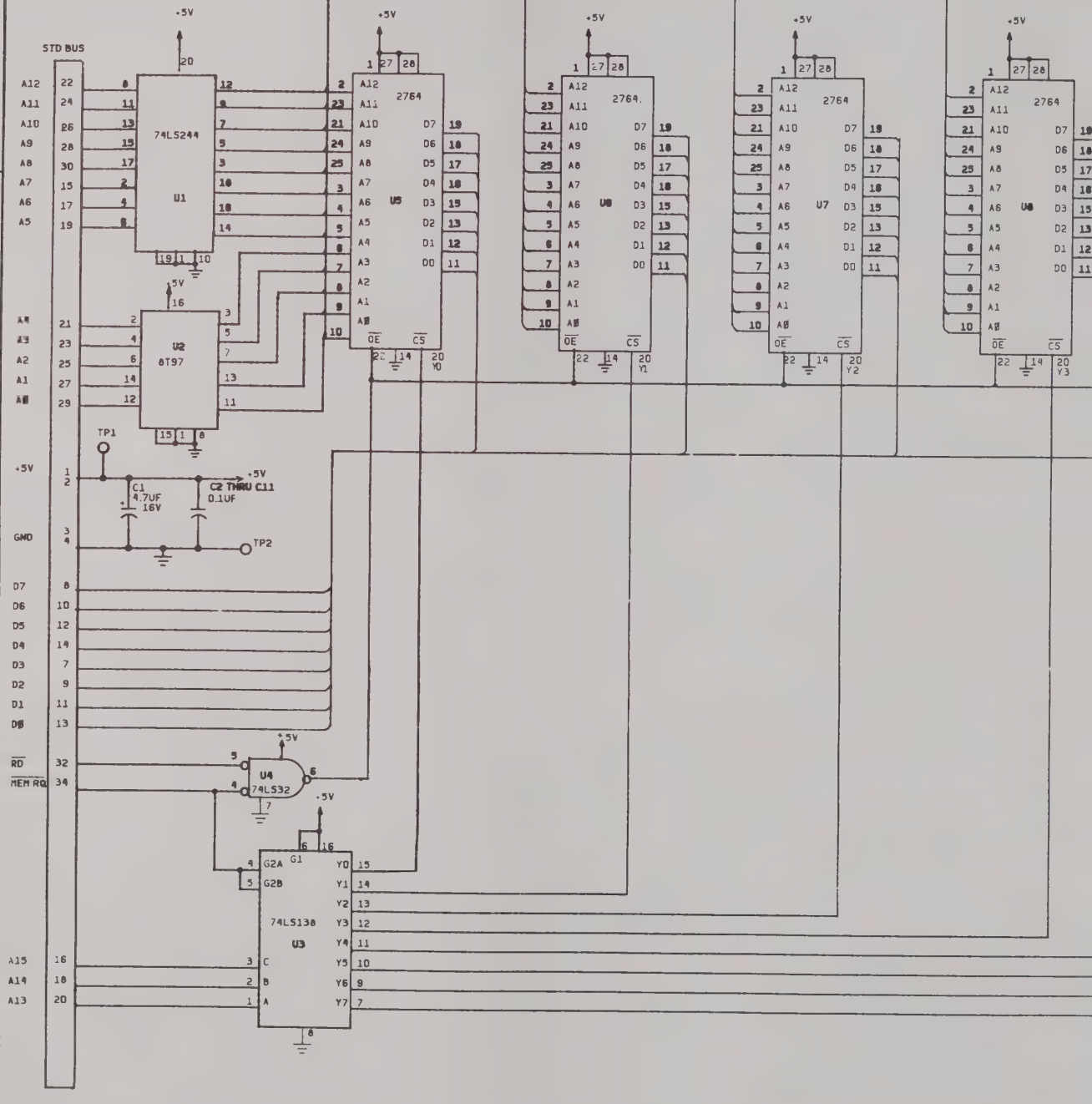
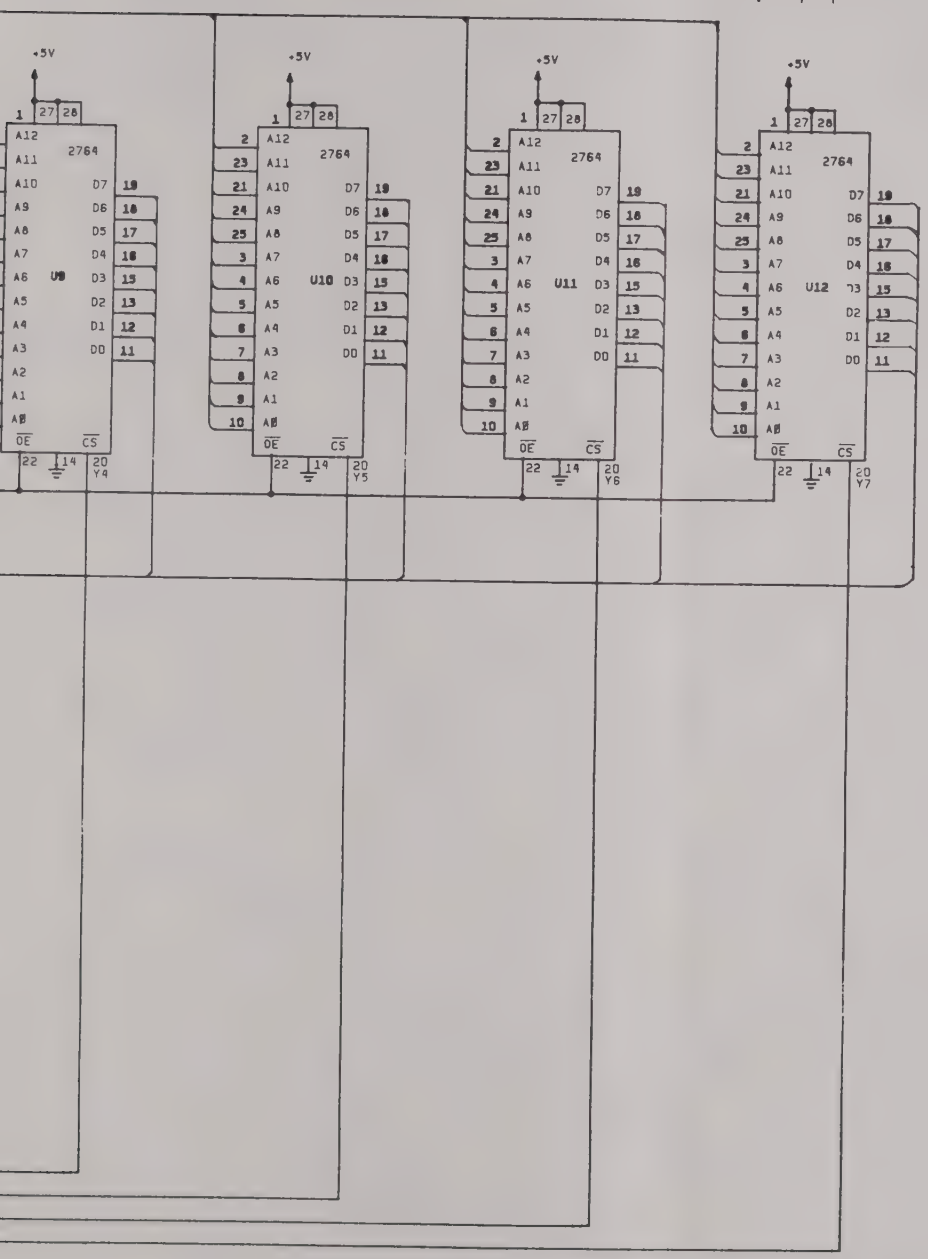
CLASS CODE

METRIC CONVERSION TABLE			
U.S. UNITS INCHES	METRIC UNITS mm	U.S UNITS INCHES	METRIC UNITS mm



NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	PCR 25046-01	3/16/84	JR



-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL: 2 PLACE ± 3 PLACE ±
ANGULAR: ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.	NAME	DATE
DRAWN	P BISHOP	10-8-83
CHECK	[illegible]	1/20/84
ELEC ENGR	[illegible]	[illegible]
MECH ENGR	[illegible]	2/1/84
APPROVED	[illegible]	2-16-84
SCHEMATIC NO.		
NEXT ASSEMBLY NO.	4-006505-001	

EATON Advanced Electronics
Eaton Corporation Electronic Instrumentation Division Los Angeles Calif

ROM CARD (64K)

A2A4

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501932	00

SCALE

SHEET 1 OF 1

4-501922 00

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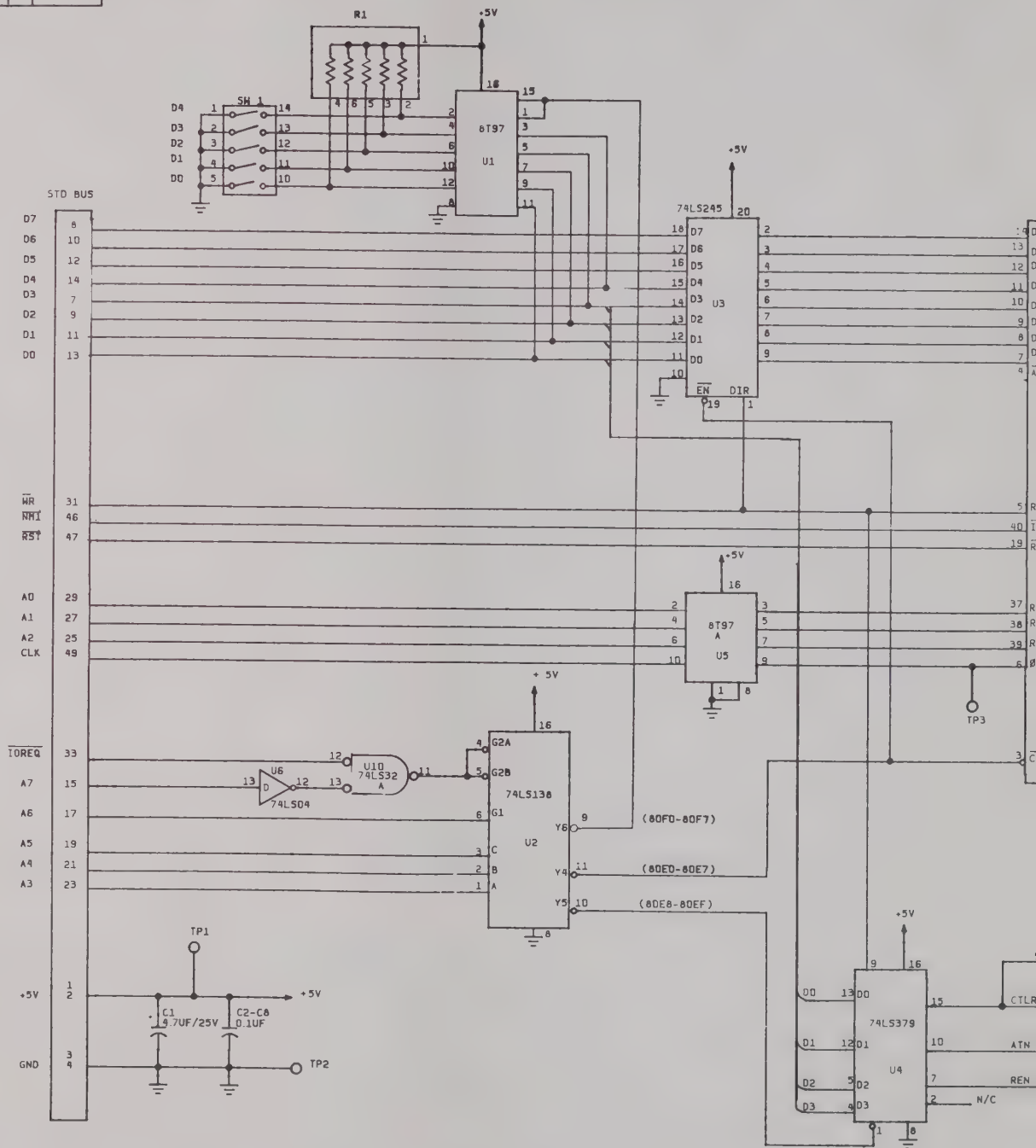
CLASS CODE

METRIC CONVERSION TABLE

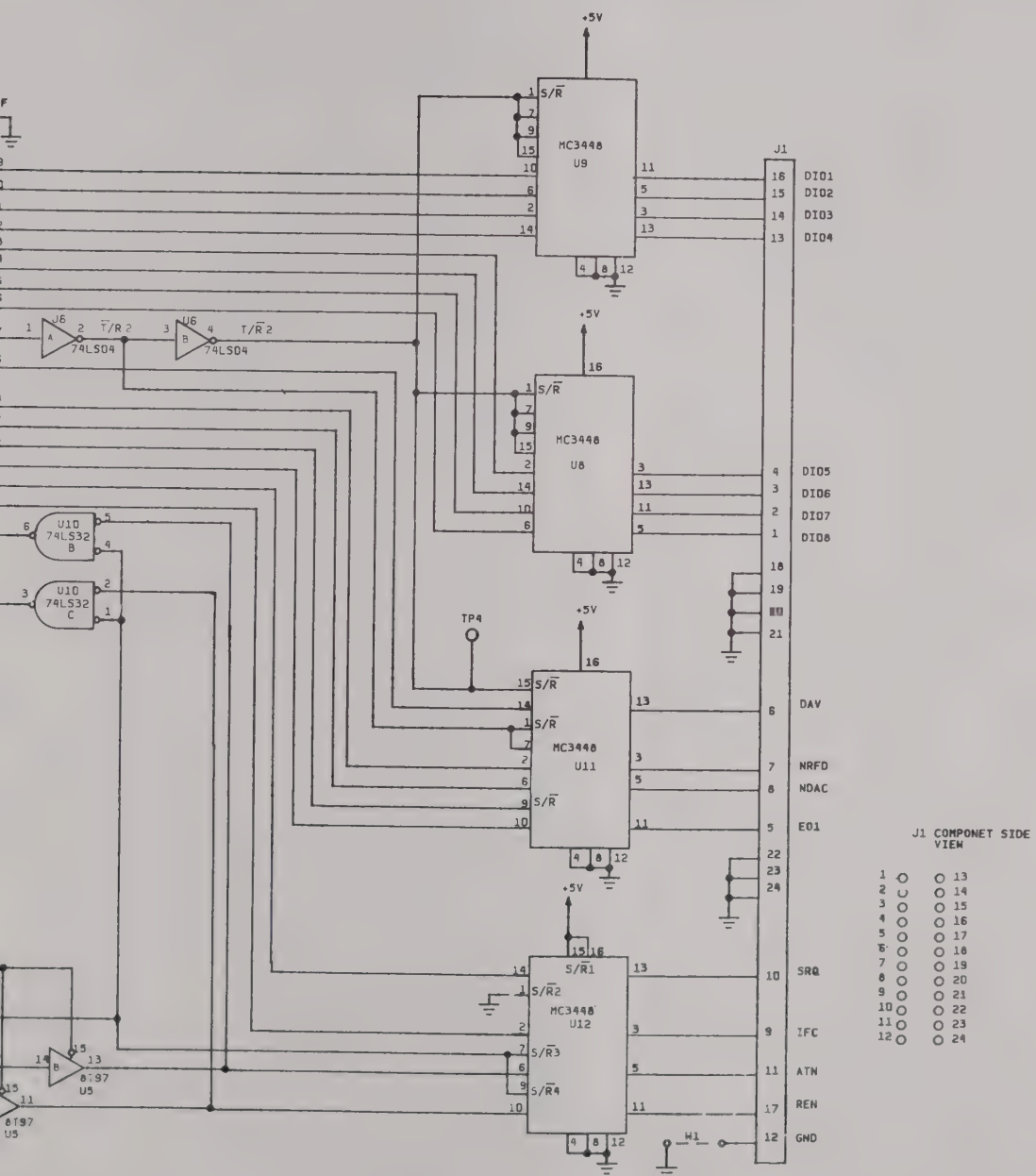
U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm



POWER SUPPLY CONNECTIONS
FOR U6 & U7
+5V PIN 14
GND PIN 7

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	PCR/EO 25046-01	2/16/84	JK



-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ± ANGULAR ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.

	NAME	DATE
DRAWN	P.BISHOP	1 20/83
CHECK	[signature]	1/27/84
ELEC ENGR		
MECH ENGR	[signature]	2/1/84
APPROVED	[signature]	2-16-84

SCHEMATIC NO

NEXT ASSEMBLY NO 4-006400

EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation Division
Los Angeles Calif

GPIB INTERFACE

A2A5

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501905	00

SCALE

SHEET 1 OF 1

4-501905 00

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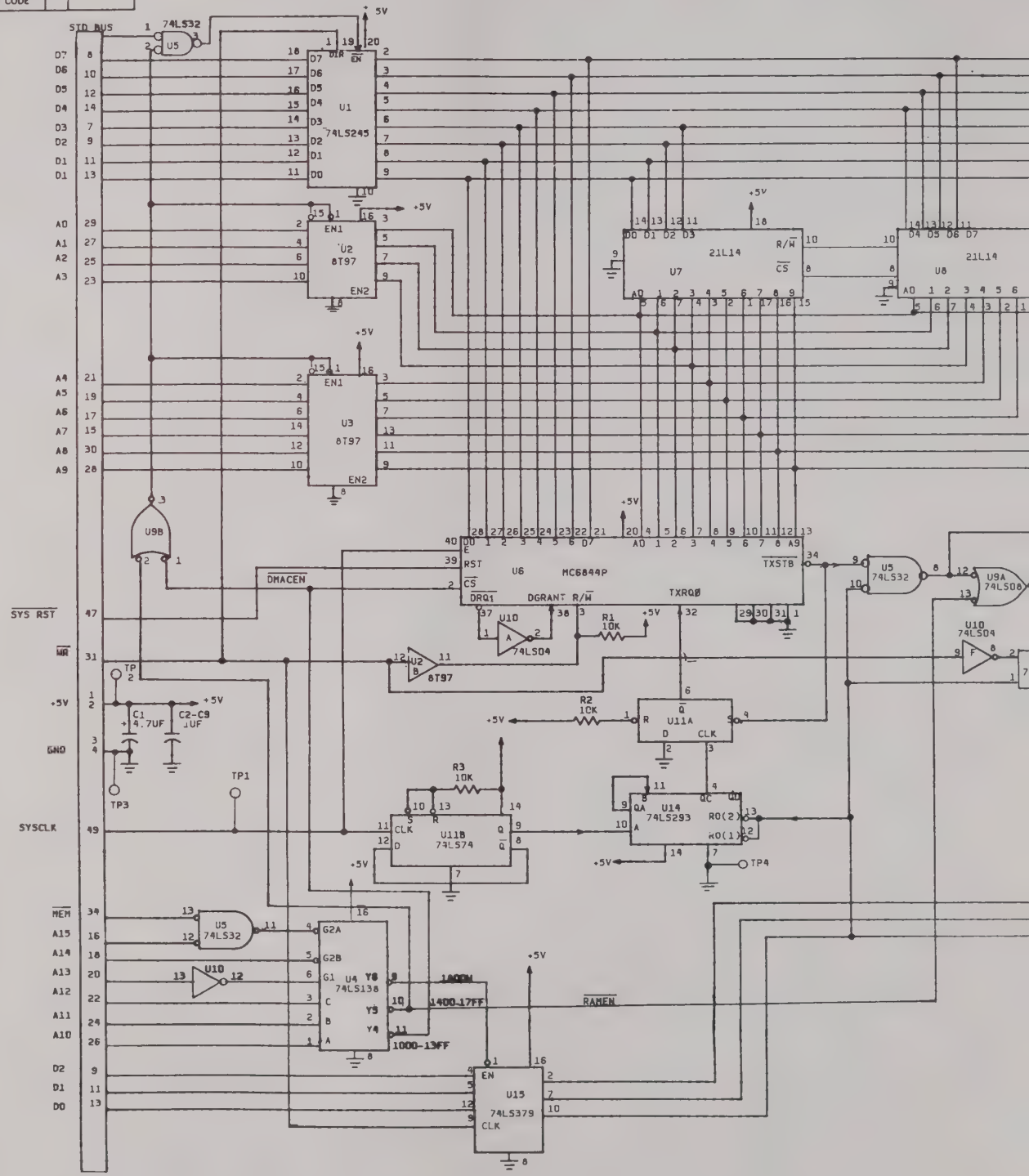
CLASS CODE

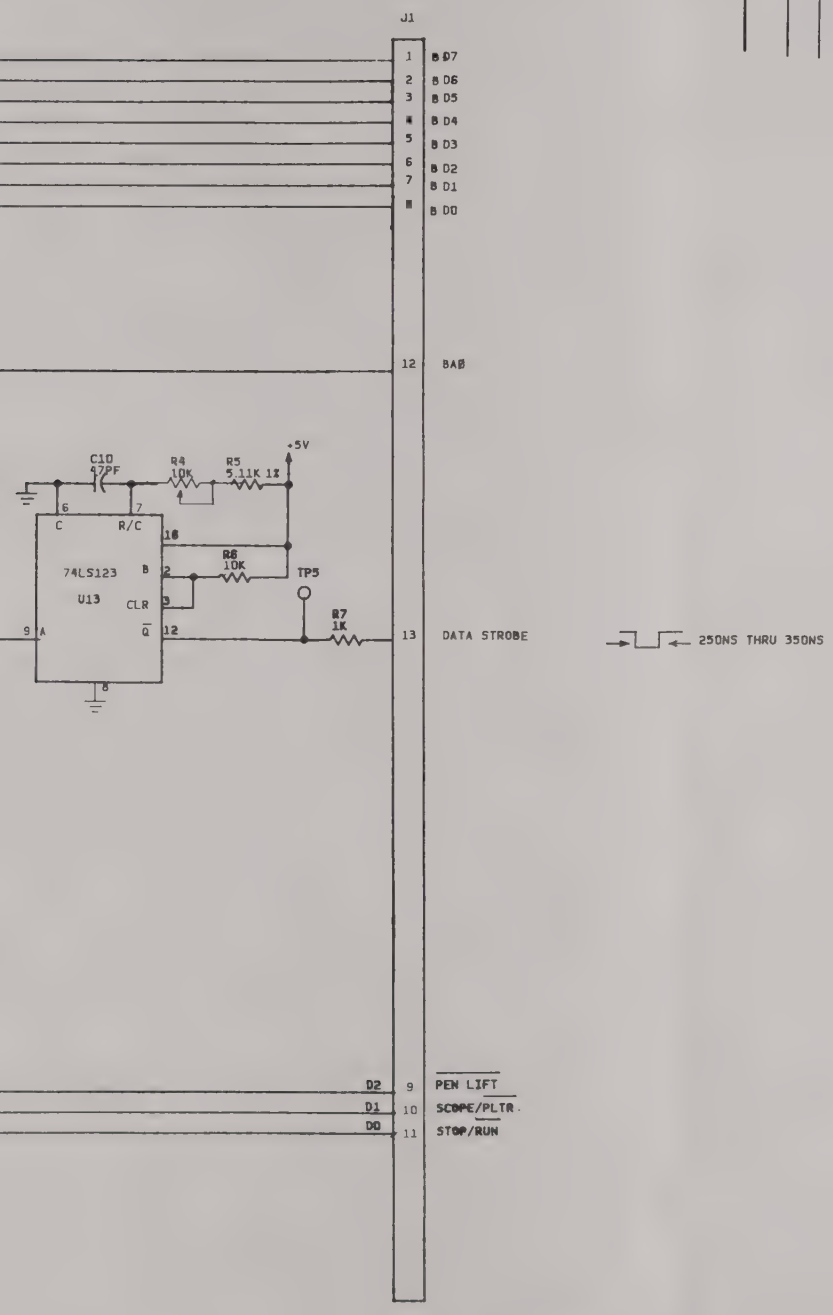
METRIC CONVERSION TABLE

U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm



NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	PCR 25046-01	3/14/84	JR



TEST POINTS

TP1 = SYS CLK
TP2 = +5
TP3 = GROUND
TP4 = GROUND
TP5 = DATA STROBE

4-006341 B

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL: 2 PLACE ± ; 3 PLACE ±
ANGULAR: ±
MATERIAL
FINISH
MODEL NO. 2075
DO NOT SCALE DRAWING

CONTRACT NO.	NAME	DATE
DRAWN	P. BISHOP	10/3/83
CHECK		1/24/84
ELEC ENGR		11/7/84
MECH ENGR		4/1/84
APPROVED		2-6-84
SCHEMATIC NO.		
NEXT ASSEMBLY NO	4-006341	

EATON Advanced Electronics
Eaton Corporation Electronic Instrumentation Division Los Angeles, Calif

DMAC & SCOPE RAM
A2A6

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501898	B
SCALE		SHEET 1 OF 2	

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CLASS CODE

METRIC CONVERSION TABLE

U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm

8 7 6 5

D C B A

J1 D7 D6 D5 D4 D3 D2 D1 D0

U18 74LS377 (VERT)

U17 74LS377 (HOR.)

U19 7524JN

U16 7524JN

U14 LF356H

U11 LF356H

U5 S/H (AD583) SHM-IC-1

U1 S/H (AD583) SHM-IC-1

U4 74LS32

U13 74LS04

U15 74LS30

U8 74LS32

U12 74LS123

U12 74LS123

U3 74LS74

U2 74LS10

U2 74LS10

U13 74LS04

U13 74LS04

U13 74LS04

STD BUS

-15V A.GND +5V D.GND +15V

TP0 TP1 TP2 TP3 TP7 TP8 TP9 TP10 TP11

REF CLK

SYSRST

RETRACE BLANK F/F

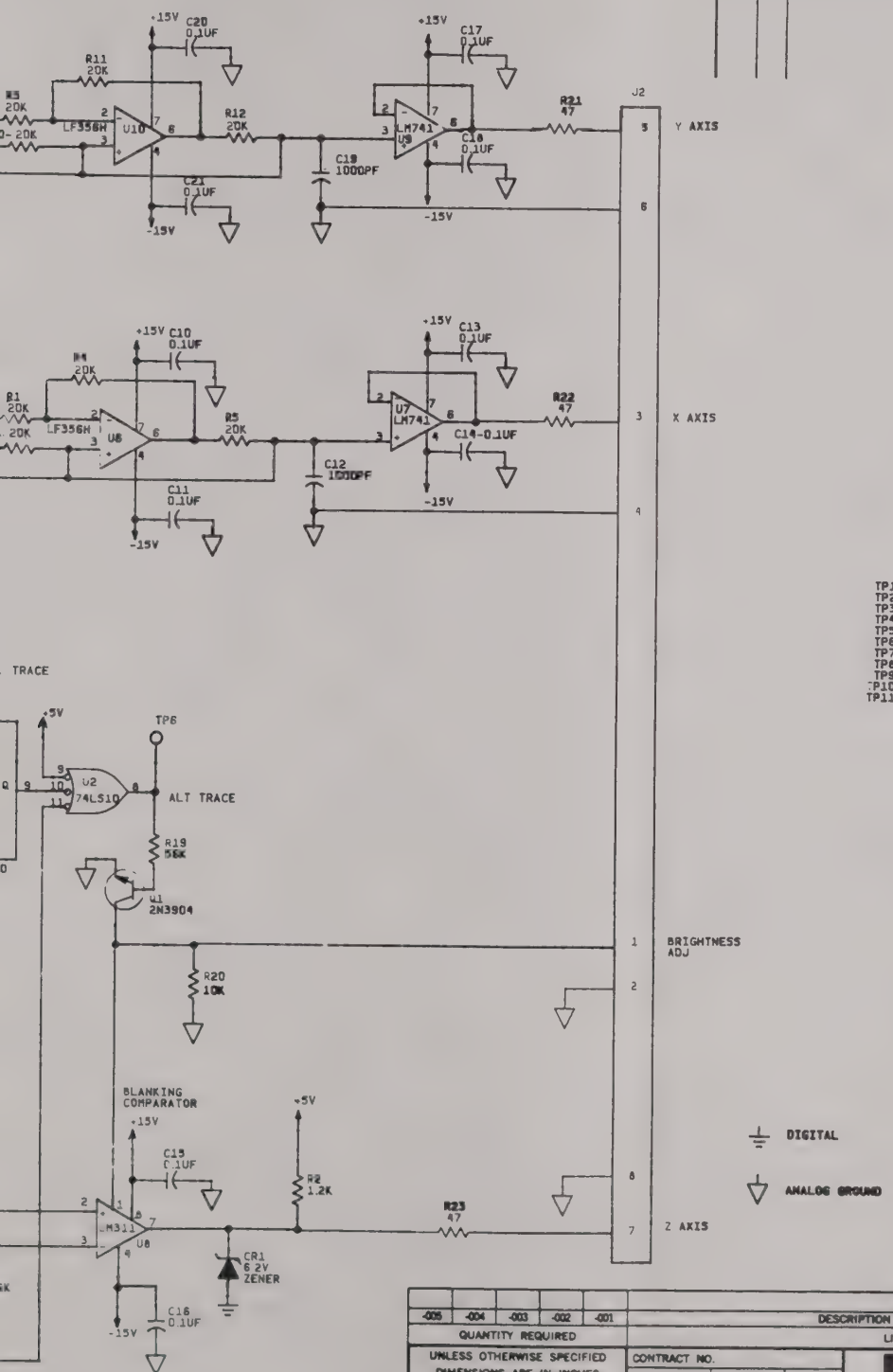
BLANK CLR

SYSRST PEN/LIFT STOP/RUN SCOPE/CTR

NOTES: UNLESS OTHERWISE SPECIFIED

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	E	PCR 25046-01	2/16/84	[illegible]

REVISIONS



TEST POINTS

TP1 +5V
TP2 D GND
TP3 REF CLK
TP4 A GND
TP5 RETRACE
TP6 ALT TRACE
TP7 DAC WR
TP8 HOR DAC
TP9 BLANK CLR
TP10 VERT DAC
TP11 REF STROBE

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ±
ANGULAR ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.

	NAME	DATE
DRAWN	P. BISHOP	1-18-84
CHECK	[illegible]	1/21/84
ELEC ENGR	[illegible]	[illegible]
MECH ENGR	[illegible]	2/1/84
APPROVED	[illegible]	2-16-84

SCHEMATIC NO.

NEXT ASSEMBLY NO. 4-006342

EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation Division
Los Angeles, Calif.

SCOPE/PLOTTER DRIVER

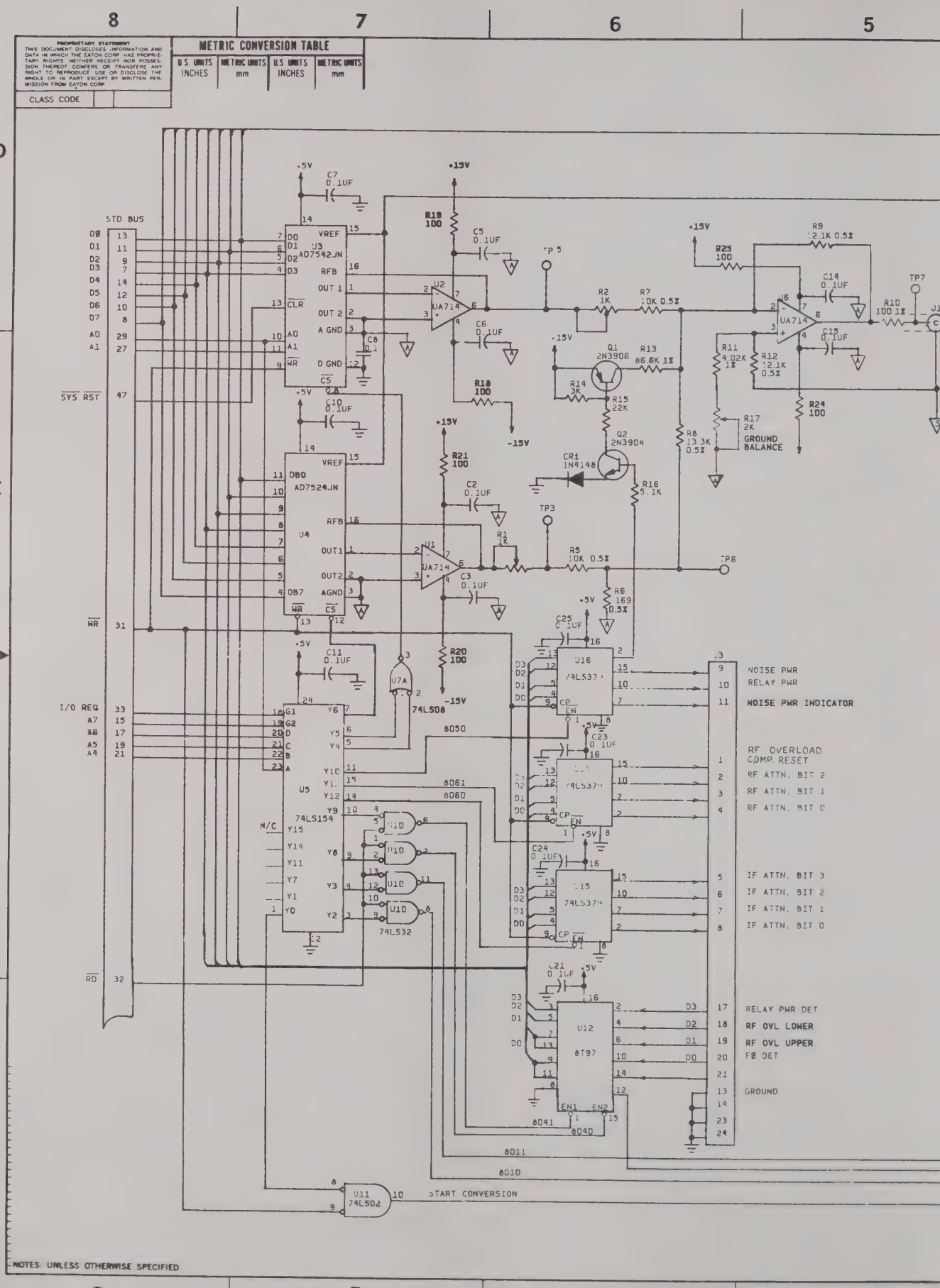
A2A7

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501899	A

SCALE

SHEET 1 OF 1

4-501899 B



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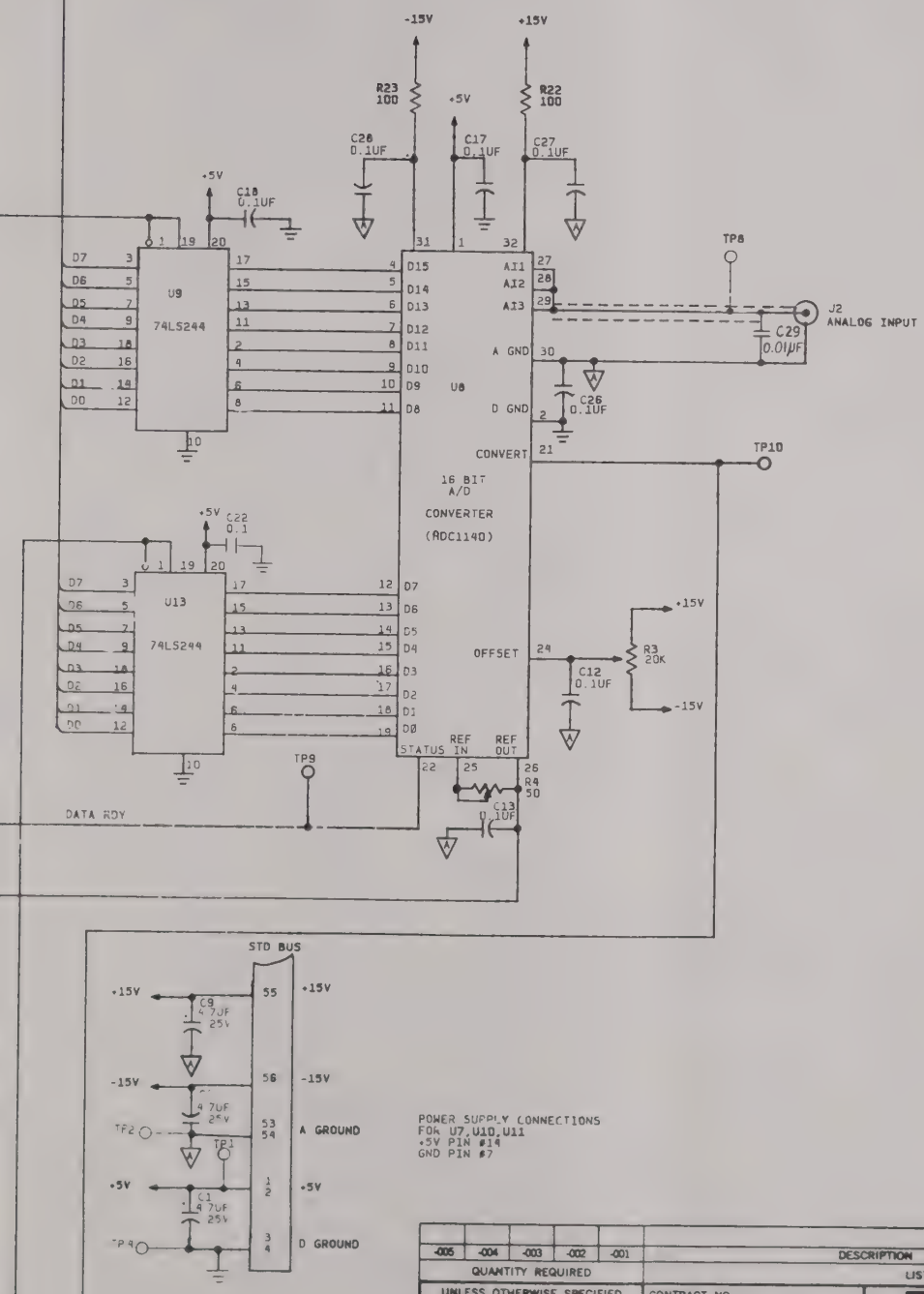
CLASS CODE
METRIC CONVERSION TABLE
U.S. UNITS INCHES
METRIC UNITS mm
U.S. UNITS INCHES
METRIC UNITS mm
STD BUS
D0
D1
D2
D3
D4
D5
D6
D7
A0
A1
SYS RST
WR
I/O REQ
A7
A6
A5
A4
RD
U3 AD7542JN
U4 AD7524JN
U5 74LS154
U2 UA714
U1 UA714
U7A 74LS08
U10 74LS32
U11 74LS02
U12 8T97
U16 74LS374
U14 74LS374
U15 74LS374
Q1 2N3906
Q2 2N3904
CR1 1N4148
R17 2K GROUND BALANCE
TP5
TP3
TP6
TP7
NOISE PWR
RELAY PWR
NOISE PWR INDICATOR
RF OVERLOAD COMP. RESET
RF ATTN. BIT 2
RF ATTN. BIT 1
RF ATTN. BIT 0
IF ATTN. BIT 3
IF ATTN. BIT 2
IF ATTN. BIT 1
IF ATTN. BIT 0
RELAY PWR DET
RF OVL LOWER
RF OVL UPPER
F0 DET
GROUND
START CONVERSION
NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00			
	A	PCR/EO 24870-01	[illegible]	[illegible]
	B	PCR/EO 25012-01	2/10/84	[illegible]



POWER SUPPLY CONNECTIONS
FOR U7,U10,U11
+5V PIN #14
GND PIN #7

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL ANGULAR
2 PLACE ± ±
3 PLACE ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.	NAME	DATE
DRAWN	P.B.	10-7-83
CHECK		
ELEC ENGR		
MECH ENGR		
APPROVED		

SCHEMATIC NO

NEXT ASSEMBLY NO.

EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation Division
Los Angeles, Calif

ANALOG/DIGITAL
I/O BOARD
A2A8

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501904	B

SCALE

SHEET 1 OF 1

4-501904 B

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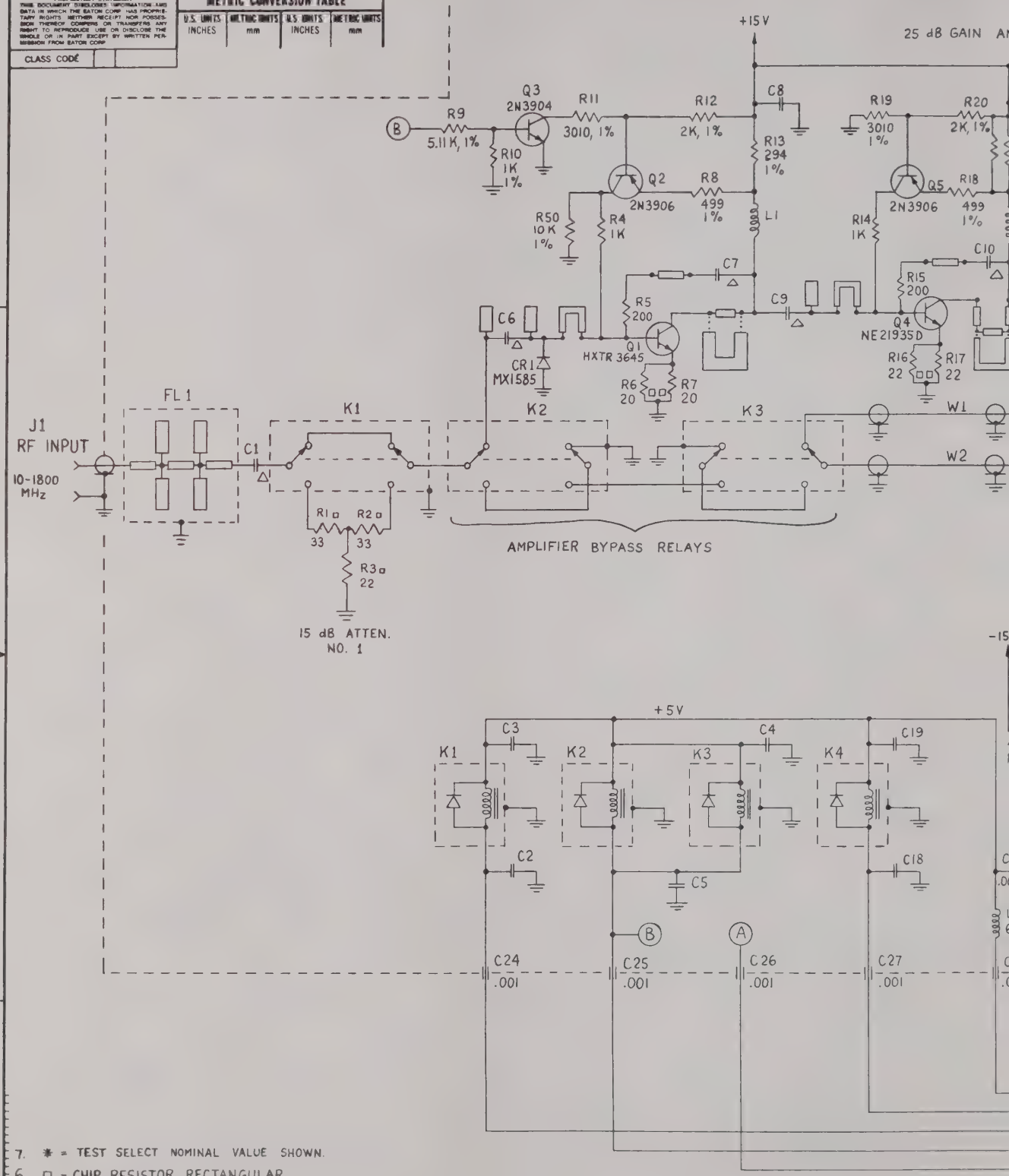
CLASS CODE

METRIC CONVERSION TABLE			
U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm

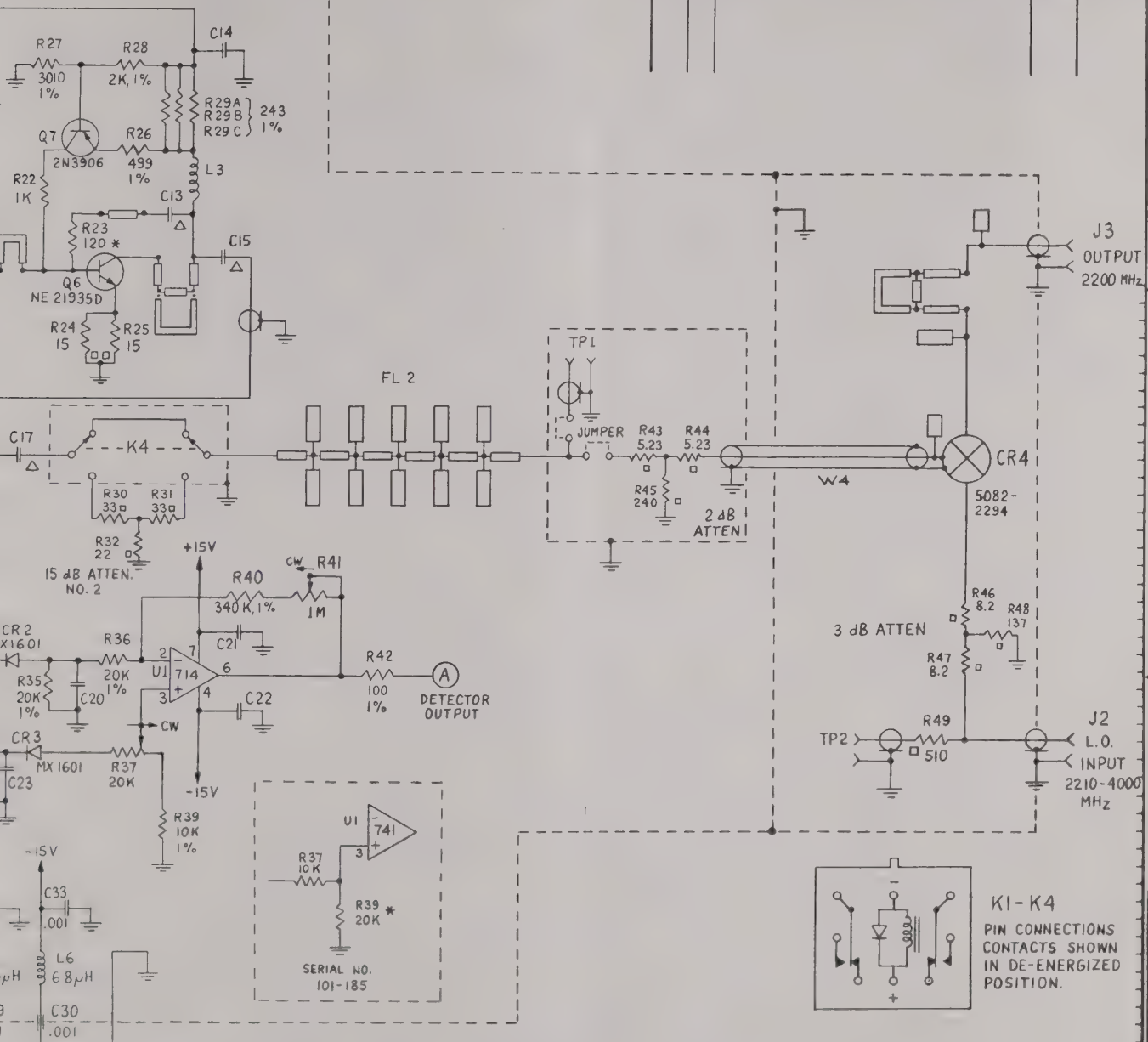


7. ✱ = TEST SELECT NOMINAL VALUE SHOWN.
6. □ = CHIP RESISTOR, RECTANGULAR OR CYLINDRICAL.
5. △ = CHIP CAPACITOR
4. INDICATES PC TRACE - MICRO STRIP
3. TO ENERGIZE RELAYS P1 PINS 5, 6, 7 ARE GROUNDED.
2. RELAY CONTACTS ARE SHOWN IN DE-ENERGIZED POSITION.
1. ALL CAPACITORS ARE .01 μF UNLESS DESIGNATED OTHERWISE.

NOTES: UNLESS OTHERWISE SPECIFIED

HIGHEST REFERENCE DESIGNATOR U									
C	CR	FL	J	K	L	P	Q	R	T
33	4	2	3	4	6	1	7	50	
NOT USED									

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	PCR/EO 25027-01	4/4/84	JL



K1-K4
PIN CONNECTIONS CONTACTS SHOWN IN DE-ENERGIZED POSITION.

SERIAL NO. 186 AND ABOVE.

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL: 2 PLACE ± 3 PLACE ±
ANGULAR ±

MATERIAL —

FINISH —

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.

	NAME	DATE
DRAWN	L. ADAM	9.1.83
CHECK		
ELEC ENGR		2/9/84
MECH ENGR		
APPROVED		2-6-84

SCHEMATIC NO 4-501910
NEXT ASSEMBLY NO 4-006418

EATON Advanced Electronics
Eaton Corporation Electronic Instrumentation Division Los Angeles Calif

SCHEMATIC
RF AMPLIFIER 10-1800 MHz
A1A3A1

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501910	00

SCALE — SHEET 1 OF 1

4-501910 00

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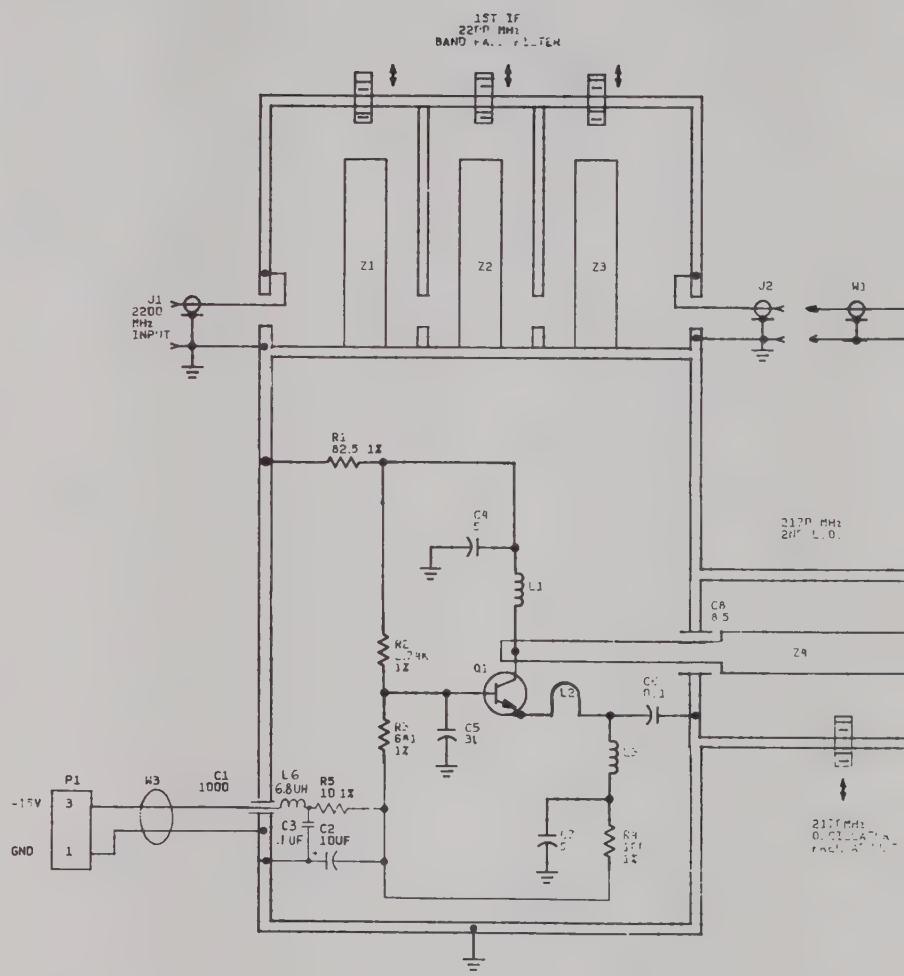
CLASS CODE

METRIC CONVERSION TABLE

U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm



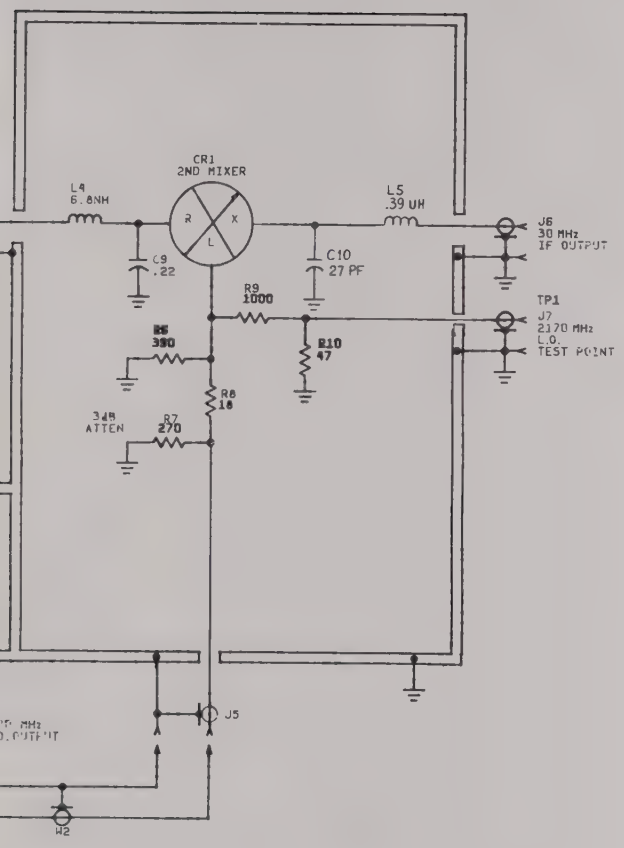
HIGHEST REFERENCE DESIGNATOR USED									
C	CR	J	L	P	Q	TP	W	Z	R
10	1	7	6	1	1	1	3	4	10
NOT USED									

5. CAPACITORS ARE IN PF.
4. RESISTORS ARE IN OHMS.
3. CR1 IS HP 5082-2277.
2. Q1 IS HP HXTR-4101

NOTE: 1. C4,C5,C6,C7,C9,L4 ARE P.C. TRACE

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	PCR/ED 24897-02	1/18/84	



-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL: 2 PLACE ± 3 PLACE ± ANGULAR ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

	NAME	DATE
CONTRACT NO.		
DRAWN	P. B	10-7-83
CHECK		
ELEC ENGR		1-16-84
MECH ENGR		
APPROVED		1-16-84
SCHEMATIC NO.		
NEXT ASSEMBLY NO.	4-006913	

EATON Advanced Electronics

Eaton Corporation Electronic Instrumentation Division Los Angeles, Calif.

A3A2
SCHEMATIC
1ST IF FILTER 2ND L.O
2ND MIXER

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501911	00

SCALE | SHEET OF

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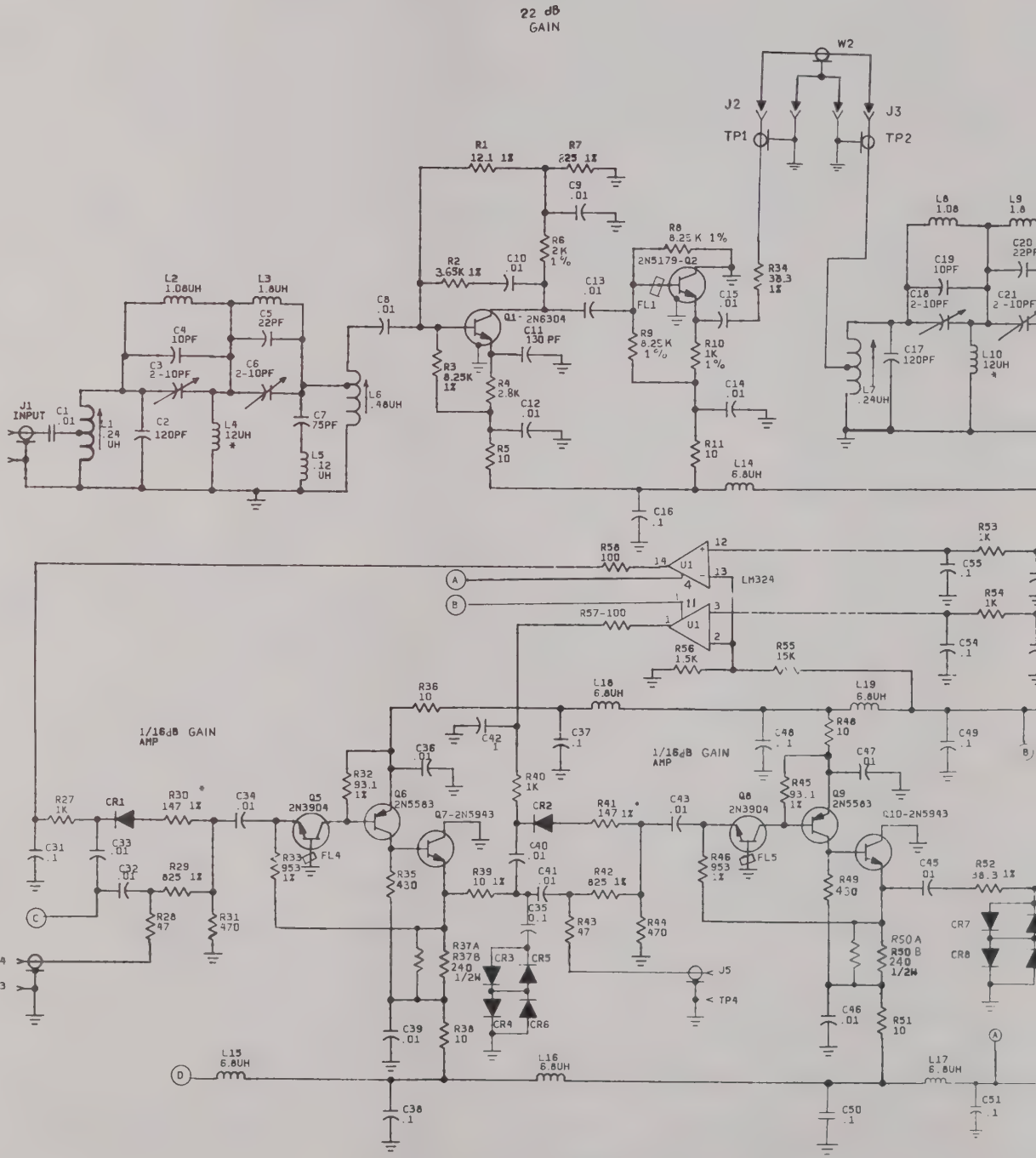
CLASS CODE

METRIC CONVERSION TABLE			
U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm



HIGHEST REF DESIGNATOR USED

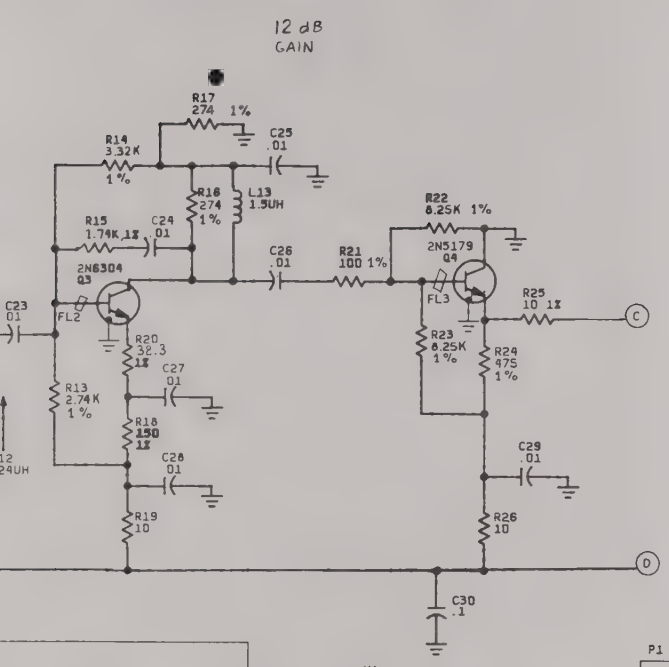
C	CR	E	FL	J	L	P	Q	R	U
55	10	5	5	6	19	1	10	58	1

REF DESIGNATOR NOT USED									
44								12 47	

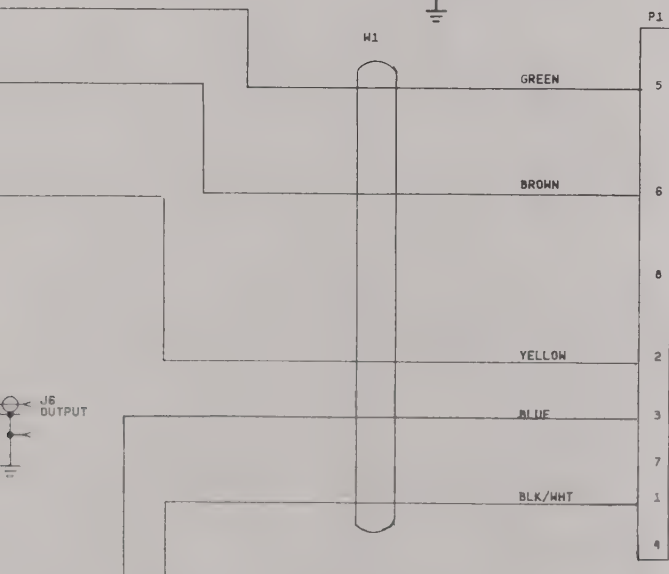
4. DIODES ARE 1N4148
3. * MAYBE CHANGE AT TEST
2. CAPACITORS ARE ALL IN UF
1. RESISTORS ARE ALL IN OHMS

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	PCR/EO 24768-02	10-31-83	JK
	A	PCR/EO 25029-01	5/11/84	JK



J1 - J6 OVERALL GAIN	VOLTAGE P1 PIN NO	
	6	5
36 - 37 dB	5	5
51 - 52 dB	5	0
66 - 67 dB	0	0



TO
A4J3

COMPONENT	SER. NO. 101 - 110	SER. NO. 111 - 135	SER. NO. 136 - UP
R2	2.55K	2.55K	3.65K
R4	2.43K	2.43K	2.8 K
C11	300 PF	300 PF	130 PF
R6	274	274	2 K
R15	3.24K	3.24K	1.74K
R20	20.5	20.5	38.3
R35	560	430	430
R37	180	R37A 240 R37B 240	R37A 240 R37B 240
R49	560	430	430
R50	180	R50A 240 R50B 240	R50A 240 R50A 240

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL: 2 PLACE ± 3 PLACE ±
ANGULAR: ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.

	NAME	DATE
DRAWN	J. BISHOP	5-7-83
CHECK		
ELEC ENGR		2/11/...
MECH ENGR		2/3/84
APPROVED		2/6/84

SCHEMATIC NO.

NEXT ASSEMBLY NO. 4-006420-001

EATON Advanced Electronics
Eaton Corporation
Electronic Instrumentation
Division
Los Angeles Calif

SCHEMATIC
30MHz PRE AMP (1ST 30MHz IF)
A3A3

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501912	A

SCALE

SHEET 1 OF 1

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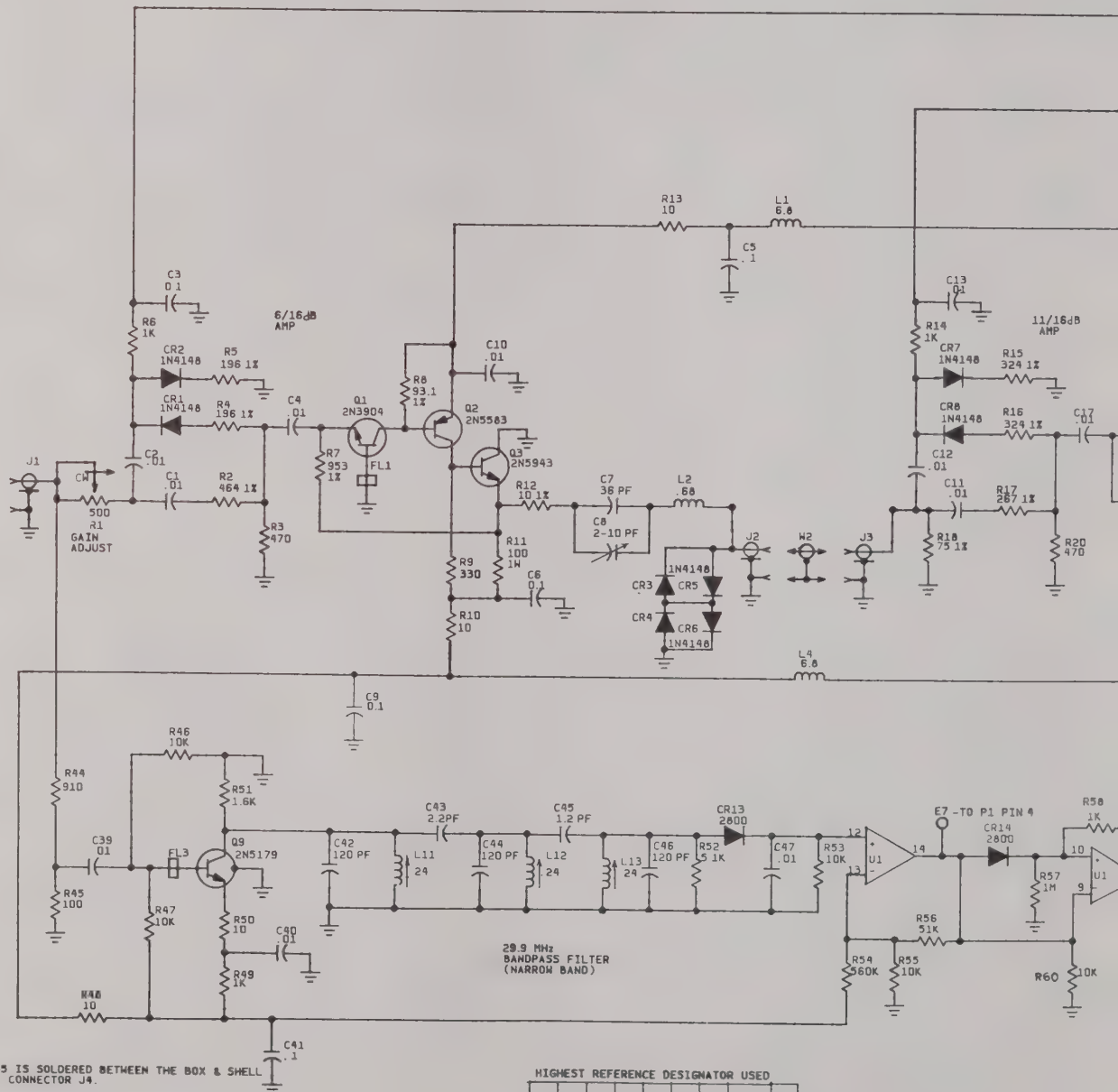
CLASS CODE

METRIC CONVERSION TABLE

U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm



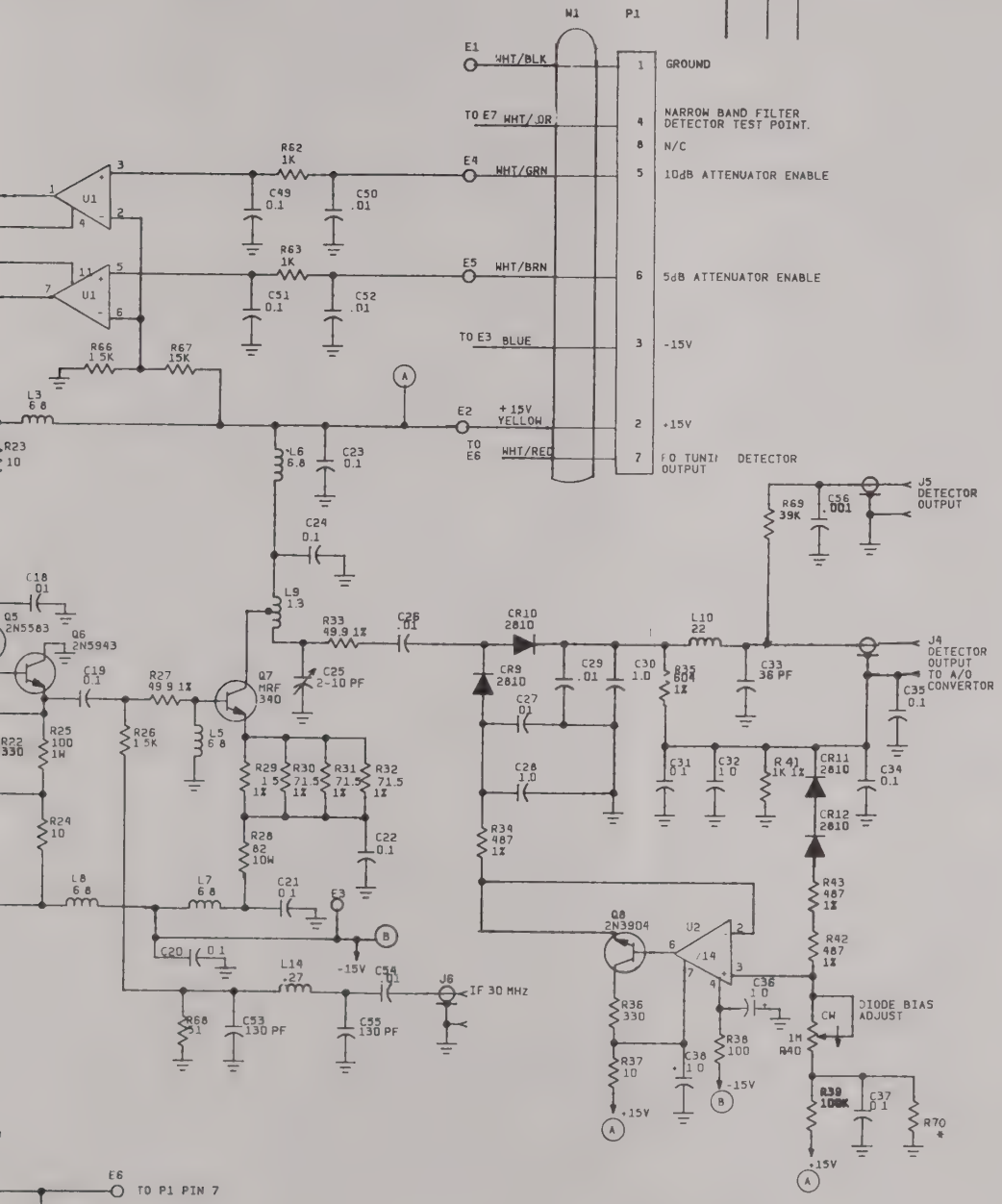
6. C35 IS SOLDERED BETWEEN THE BOX & SHELL OF CONNECTOR J4.
5. ALL COILS ARE IN MICROHENRYS.
4. U1 IS LM-324
3. * MAY BE INSTALLED AT TEST.
2. ALL RESISTORS ARE IN OHMS UNLESS NOTED.
1. ALL CAPACITORS ARE IN UF UNLESS NOTED.

HIGHEST REFERENCE DESIGNATOR USED

C	CR	E	FL	L	R	Q	J	U
56	15	7	3	14	70	9	6	2

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	PCR/EO 24764 - 02	10/28/83	JK
	A	PCR/EO 25028-01	2/16/84	JK



-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ±
ANGULAR ±

MATERIAL

FINISH

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.

	NAME	DATE
DRAWN	P. BISHOP	5-7-83
CHECK		
ELEC ENGR	Roy Keeney	2/7/84
MECH ENGR	[illegible]	2/2/84
APPROVED	[illegible]	2-16-84

SCHEMATIC NO.

NEXT ASSEMBLY NO. 4-006421

EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation Division
Los Angeles, Calif.

SCHEMATIC
2ND 30 MHz IF, DETECTOR
A3A4

SIZE	FSCM NO	DWG NO	REV
D	88869	4-501913	A

SCALE SHEET OF

4-501913 A

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CLASS CODE

METRIC CONVERSION TABLE

U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm

+15V YELLOW — 2

GROUND WHT/BLK — 1

-15V BLUE — 3

+30V ORANGE — 8

+30V COMMON GREY — 7

J2

C1 47

R1 20K 1%

CR3 1N4148

R2 5K CW

R3 31.6K 1%

741 U1

HIGH FREQ VC ADJ.

C2 1

FROM A2A8 J1

.072 TO 10.200 V FOR 2200 TO 4000 MHz

J1

TP3

TP4

R6 49.9K 1%

R7 2.32K 1%

R8 1K CW

R9 976 1%

LOW FREQ VC ADJ.

R12 36.5K 0.5%

C4 1

R16 10K

LOW FREQ ADJ.

R14 5K CW

HIGH FREQ ADJ.

R15 22.9K 0.5%

R13 1.62K 1%

C5 10

6.95V

VOLTAGE REFERENCE

U3 LM399

714 U2

R17 6.04K 0.5%

C6 47

C7 47

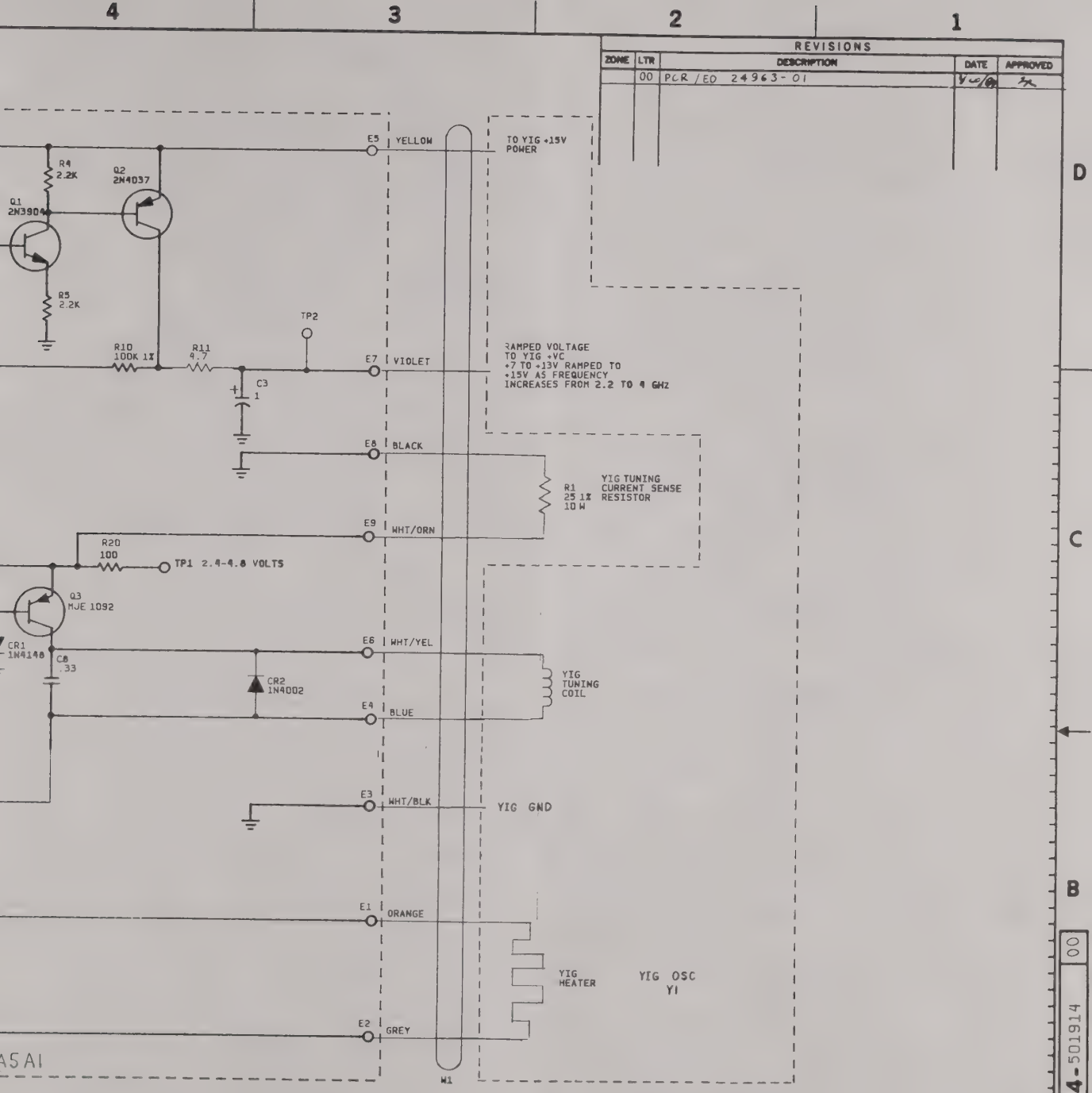
R21 30 1/2W

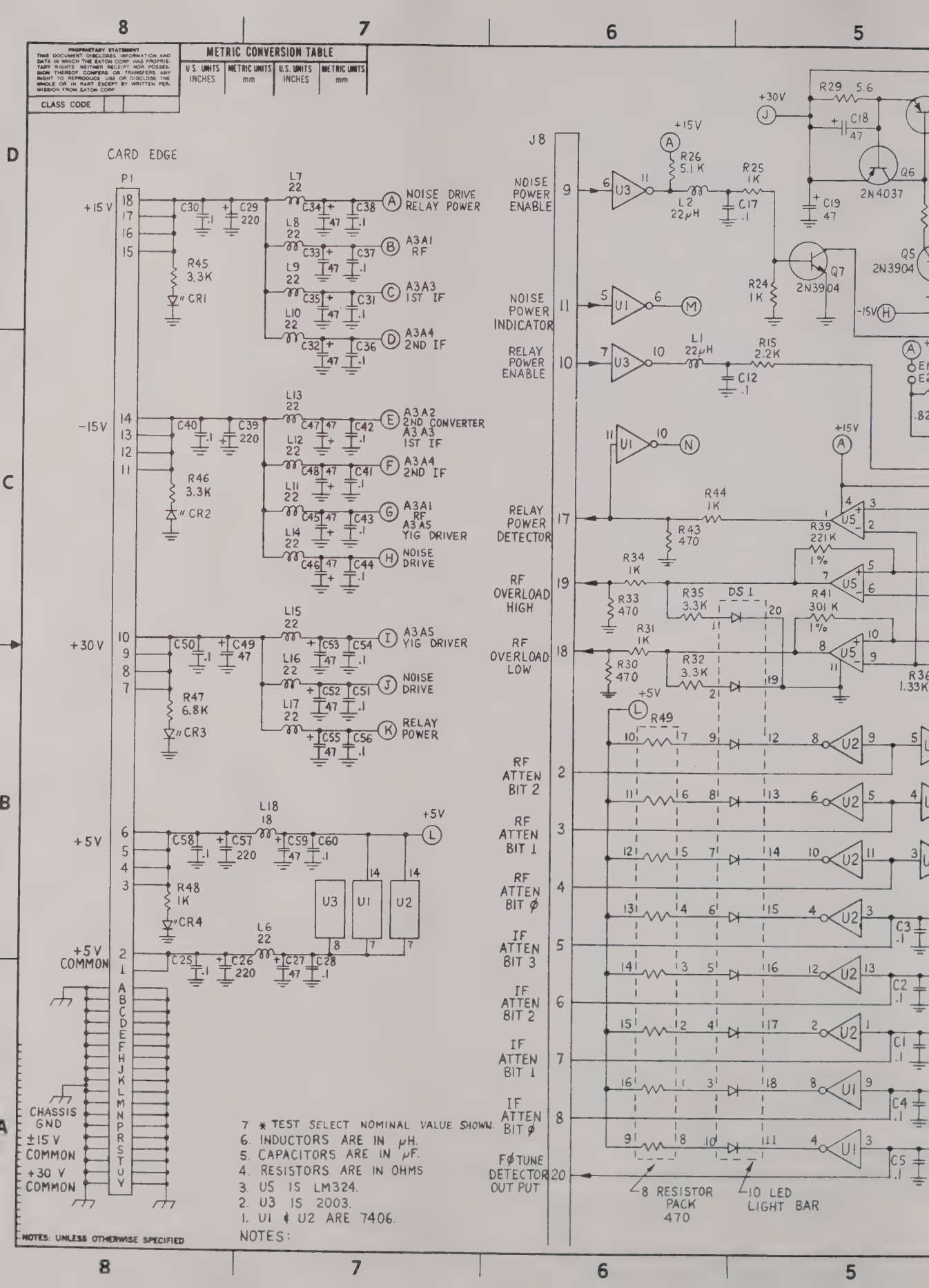
HIGHEST REFERENCE DESIGNATOR USED								
C	CR	E	P	Q	R	TP	U	W
9	3	14	1	3	21	2	3	2
NOT USED								

2. ALL CAPACITORS ARE IN UF.

1. ALL RESISTORS ARE IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED


REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
00 PCR/ED 24963-01
E5 YELLOW
TO YIG +15V POWER
R4 2.2K
Q2 2N4037
Q1 2N3904
R5 2.2K
TP2
R10 100K 1%
R11 4.7
C3 1
E7 VIOLET
RAMPED VOLTAGE TO YIG +VC +7 TO +13V RAMPED TO +15V AS FREQUENCY INCREASES FROM 2.2 TO 4 GHz
E8 BLACK
R1 25 1% 10 W
YIG TUNING CURRENT SENSE RESISTOR
E9 WHT/ORN
R20 100
TP1 2.4-4.8 VOLTS
Q3 MJE 1092
CR1 1N4148
C8 .33
CR2 1N4002
E6 WHT/YEL
YIG TUNING COIL
E4 BLUE
E3 WHT/BLK
YIG GND
E1 ORANGE
YIG HEATER
YIG OSC Y1
E2 GREY
W1
A5A1
4-501914 00
-005 -004 -003 -002 -001
QUANTITY REQUIRED
DESCRIPTION
PART NO.
ITEM
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ±
ANGULAR ±
CONTRACT NO.
NAME DATE
DRAWN P. BISHOP 1-18-84
CHECK
ELEC ENGR 1-19-84
MECH ENGR 1/29/84
APPROVED 2/2/84
MATERIAL
FINISH
MODEL NO. 2075
SCHEMATIC NO.
NEXT ASSEMBLY NO. 4 [illegible]6425-001
DO NOT SCALE DRAWING
EATON Advanced Electronics
Eaton Corporation Electronic Instrumentation Division Los Angeles Calif
SCHEMATIC
1ST L.O. (YIG) DRIVER ASSY.
A3A5
SIZE D
FSCM NO 88869
DWG NO 4-501914
REV 00
SCALE
SHEET OF



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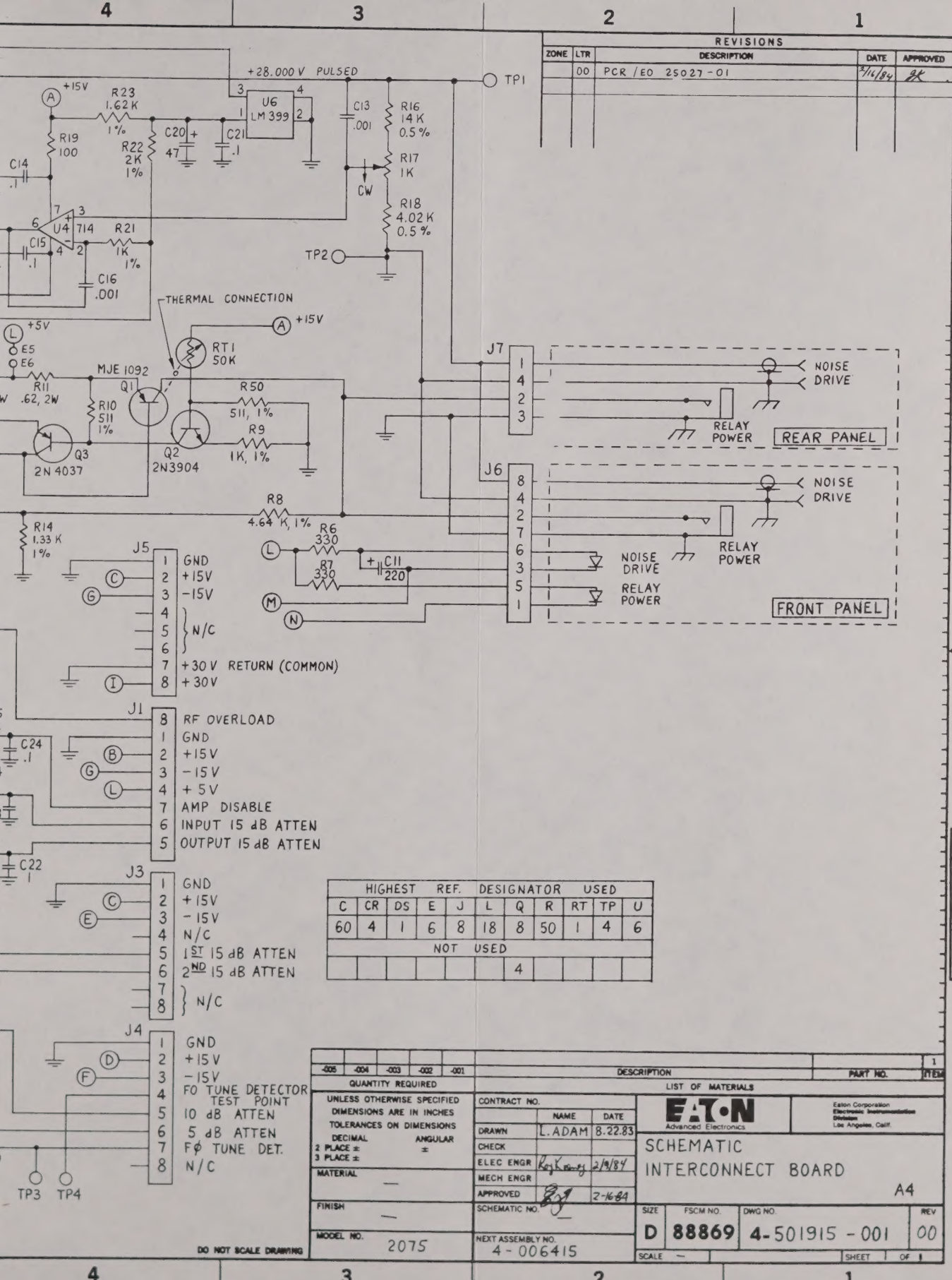
CLASS CODE
METRIC CONVERSION TABLE
U.S. UNITS INCHES
METRIC UNITS mm
U.S. UNITS INCHES
METRIC UNITS mm
CARD EDGE
P1
+15 V
-15V
+30 V
+5V
+5V COMMON
CHASSIS GND
±15 V COMMON
+30 V COMMON
NOISE DRIVE RELAY POWER
A3A1 RF
A3A3 1ST IF
A3A4 2ND IF
A3A2 2ND CONVERTER A3A3 1ST IF
A3A4 2ND IF
A3A1 RF A3A5 YIG DRIVER
NOISE DRIVE
A3A5 YIG DRIVER
NOISE DRIVE
RELAY POWER
J8
NOISE POWER ENABLE
NOISE POWER INDICATOR
RELAY POWER ENABLE
RELAY POWER DETECTOR
RF OVERLOAD HIGH
RF OVERLOAD LOW
RF ATTEN BIT 2
RF ATTEN BIT 1
RF ATTEN BIT ϕ
IF ATTEN BIT 3
IF ATTEN BIT 2
IF ATTEN BIT 1
IF ATTEN BIT ϕ
FϕTUNE DETECTOR OUT PUT
8 RESISTOR PACK 470
10 LED LIGHT BAR
2N4037
2N3904
2N3904
NOTES: UNLESS OTHERWISE SPECIFIED
7 * TEST SELECT NOMINAL VALUE SHOWN.
6. INDUCTORS ARE IN μH.
5. CAPACITORS ARE IN μF.
4. RESISTORS ARE IN OHMS
3. U5 IS LM324.
2. U3 IS 2003.
1. U1 & U2 ARE 7406.
NOTES:


REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
00 | PCR / EO 25027-01 | 3/16/84 | JK
+28.000 V PULSED
TP1
U6 LM 399
R23 1.62K 1%
R19 100
R22 2K 1%
C20 47
C21 .1
C13 .001
R16 14K 0.5%
R17 1K CW
R18 4.02K 0.5%
TP2
U4 714
R21 1K 1%
C14 .1
C15 .1
C16 .001
THERMAL CONNECTION
RT1 50K
MJE 1092
Q1
Q2 2N3904
Q3 2N 4037
R11 .62, 2W
R10 511 1%
R50 511, 1%
R9 1K, 1%
R8 4.64 K, 1%
R14 1.33 K 1%
R6 330
R7 330
C11 220
J7
NOISE DRIVE
RELAY POWER
REAR PANEL
J6
NOISE DRIVE
RELAY POWER
NOISE DRIVE
RELAY POWER
FRONT PANEL
J5
1 GND
2 +15V
3 -15V
4 N/C
5 N/C
6 N/C
7 +30 V RETURN (COMMON)
8 +30 V
J1
8 RF OVERLOAD
1 GND
2 +15 V
3 -15 V
4 + 5 V
7 AMP DISABLE
6 INPUT 15 dB ATTEN
5 OUTPUT 15 dB ATTEN
J3
1 GND
2 +15 V
3 - 15 V
4 N/C
5 1ST 15 dB ATTEN
6 2ND 15 dB ATTEN
7 N/C
8 N/C
J4
1 GND
2 +15 V
3 -15 V
4 FO TUNE DETECTOR TEST POINT
5 10 dB ATTEN
6 5 dB ATTEN
7 FØ TUNE DET.
8 N/C
TP3
TP4
HIGHEST REF. DESIGNATOR USED
C | CR | DS | E | J | L | Q | R | RT | TP | U
60 | 4 | 1 | 6 | 8 | 18 | 8 | 50 | 1 | 4 | 6
NOT USED
4
-005 -004 -003 -002 -001
QUANTITY REQUIRED
DESCRIPTION
PART NO.
ITEM
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL ANGULAR
2 PLACE ± ±
3 PLACE ±
MATERIAL —
FINISH —
MODEL NO. 2075
DO NOT SCALE DRAWING
CONTRACT NO.
NAME DATE
DRAWN L. ADAM 8.22.83
CHECK
ELEC ENGR 2/9/84
MECH ENGR
APPROVED 2-16-84
SCHEMATIC NO. —
NEXT ASSEMBLY NO. 4-006415
EATON Advanced Electronics
Eaton Corporation Electronic Instrumentation Division Los Angeles, Calif.
SCHEMATIC
INTERCONNECT BOARD
A4
SIZE D
FSCM NO. 88869
DWG NO. 4-501915-001
REV 00
SCALE —
SHEET 1 OF 1
4-501915 00

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CLASS CODE 00 00020

METRIC CONVERSION TABLE

U.S. UNITS INCHES	METRIC UNITS mm	U.S. UNITS INCHES	METRIC UNITS mm

GPIB

NOISE DRIVE
RELAY POWER
AC LINE
A1A5W3J1
A1A5W5J1
A1A5W5J2
CHASSIS GND

A1A5
REAR PANEL ASSY
(4-006462-001)

POWER SUPPLY
(1-404674-001)
+5V | +5V COM | +15V | ±15V COM | -15V

FAN
(1-939 005-001)

A1A5W3
A1A5W6
A1A5W2
A1A5W4
A1W3
A1A5W2P1
A1W3J2
A1A5W1
CHASSIS GND

A1A2
DIGITAL SECTION

A1A5W1P1
A1A2A9W1J1
A1A2A9W1
A1W3J1
A1A4P1

A1A2A9
MOTHER BOARD
(4-006417-001)

A1A2A9J1 | A1A2A1P1
A1A2A9J2 | A1A2A2P1
A1A2A9J3 | A1A2A3P1
A1A2A9J4 | A1A2A4P1
A1A2A9J5 | A1A2A5P1
A1A2A9J6 | A1A2A6P1
A1A2A9J7 | A1A2A7P1
A1A2A9J8 | A1A2A8P1

A1A2A1 FRONT PANEL I/O, APU (4-006343-001)
A1A2A1J1 | A1W2P1

A1A2A2 RAM1/BATTERY BACK UP RAM (4-006344-001)

A1A2A3 CPU (4-006514-001)

A1A2A4 ROM1 (4-006540-001)

A1A2A5 GPIB I/O (4-006400-001)
A1A2A5J1 | A1A5W6P1

A1A2A6 DMAC RAM (4-006341-001)
A1A2A6J1 | A1W9P1

A1A2A7 SCOPE DRIVER (4-006342-001)
A1A2A7J1 | A1W9P2
A1A2A7J2 | A1A5W4P1

A1A2A8 ANALOG/DIGITAL I/O (4-006347-001)
A1A2A8J1 | A1W6P2
A1A2A8J2 | A1W7P1
A1A2A8J3 | A1W8P2

A1A4 INTERCONNECT BOARD (4-006415-001)
A1A4J2
A1A4J3
A1A4J4
A1A4J5 | A1W5P1
A1A4J1
A1A4J6 | A1A1W1P1
A1A4J7 | A1A5W5P1
A1A4J8 | A1W8P1

A1W2
A1W9
A1W8
A1W6

A1A1A2
DISPLAY
(4-006345-001)
A1W2P3 | A1A1A2J2

A1A1A1
KEYBOARD
(4-006346-001)
A1W2P2 | A1A1A1J1

A1A1W1

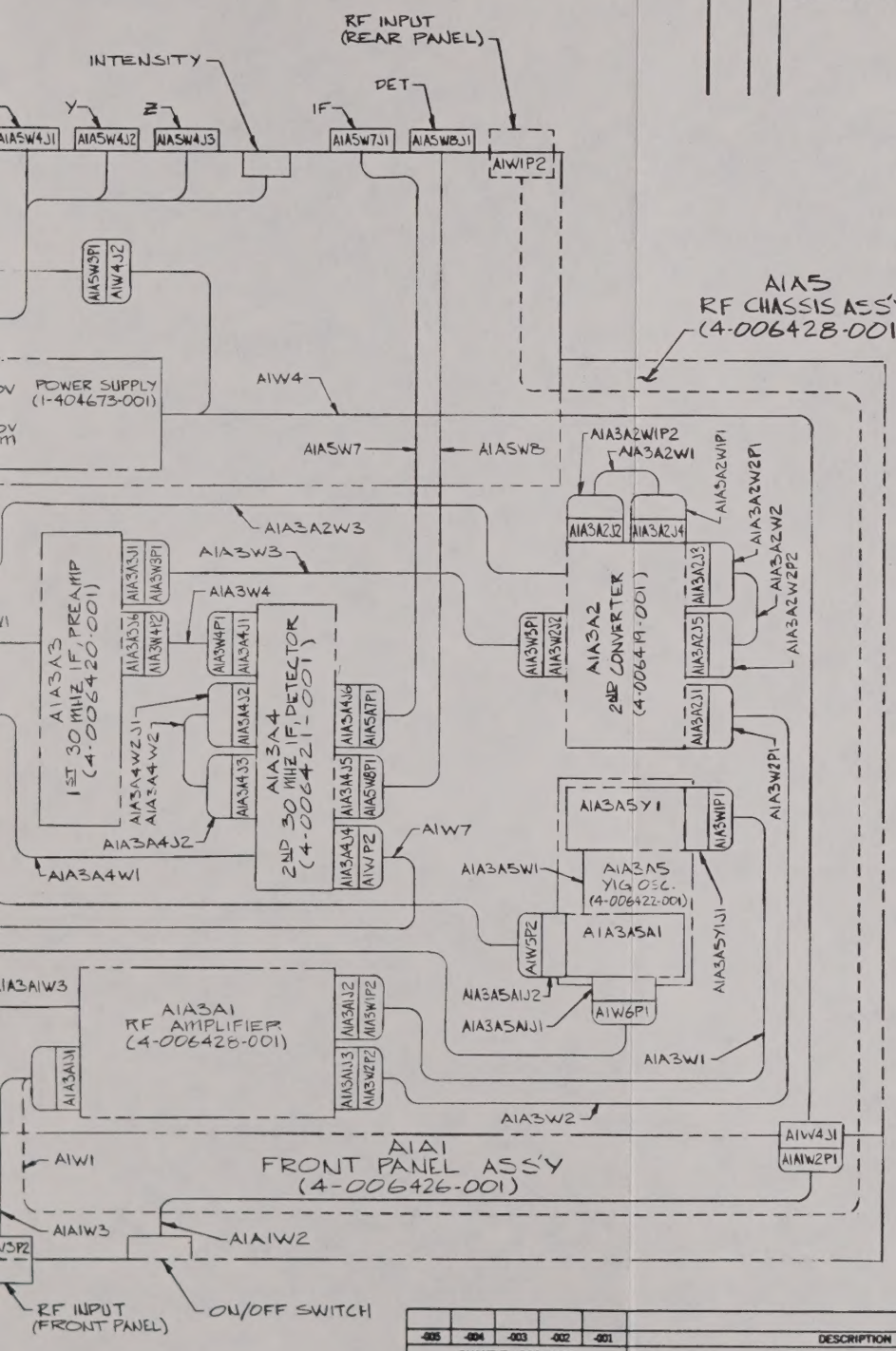
NOISE DRIVE
RELAY POWER

INTERCONNECT DIAGRAM

SEE SH1

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		SEE SH. 1		



CABLE CHART	
ASSY No.	DRWG No.
A1W1	4-006499-002
A1W2	1-006464-001
A1W3	2-006492-001
A1W4	3-006489-001
A1W5	2-006521-001
A1W6	2-006502-002
A1W7	2-006501-003
A1W8	4-006463-001
A1W9	1-006490-001
A1A1W1	3-006500-001
A1A1W2	1-006491-001
A1A1W3	1-006499-001
A1A2A9W1	1-006497-001
A1A3W1	1-006503-001
A1A3W2	1-006504-001
A1A3W3	1-006502-001
A1A3W4	1-006501-002
A1A3A1W3	2-006495-001
A1A3A2W1	2-006451-001
A1A3A2W2	2-006452-001
A1A3A2W3	1-006453-001
A1A3A3W1	2-006495-002
A1A3A4W1	2-006495-003
A1A3A4W2	1-006501-001
A1A3A5W1	2-006496-001
A1A5W1	1-006466-002
A1A5W2	1-006466-001
A1A5W3	3-006494-001
A1A5W4	3-006493-001
A1A5W5	4-006525-001
A1A5W6	4-006498-001
A1A5W7	1-006467-001
A1A5W8	1-006467-002

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± — 3 PLACE ± —
ANGULAR ± —

MATERIAL P/L

FINISH —

MODEL NO. 2075

DO NOT SCALE DRAWING

CONTRACT NO.	NAME	DATE
DRAWN	N. RATCLIFF	11/9/83
CHECK	[illegible]	11/14/83
ELEC ENGR	[illegible]	11/21/83
MECH ENGR	[illegible]	11/23/83
APPROVED	[illegible]	11-23

SCHEMATIC NO. 4-501897-001

NEXT ASSEMBLY NO. 1-006526-001

EATON Advanced Electronics

Eaton Corporation
Electronic Instrumentation Division
Los Angeles, Calif.

FINAL ASSEMBLY
MODEL 2075
(INTERCONNECT DIAGRAM)

SIZE	FSCM NO.	DWG NO.	REV
D	88869	4-006430	E

SCALE — SHEET 4 OF 4

4-006430 E